ANUS · RECTUM SIGMOID COLON

Diagnosis and Treatment

VOLUME TWO

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ANUS · RECTUM SIGMOID COLON

Diagnosis and Treatment

BY

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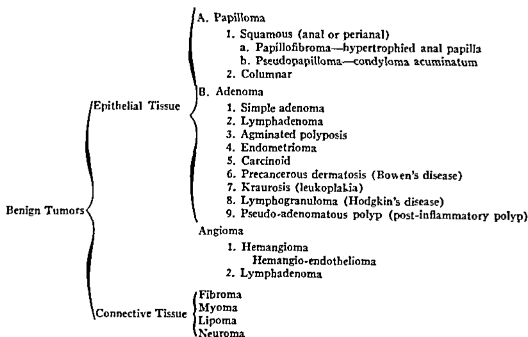
Benign Tumors

DESCRIPTION

Benign or nonmalignant tumors are composed of cells and intercellular substance arranged typically and systematically as tissues portraying normal relations, but functionally inert. They may be congenital or acquired, are usually encapsulated, have a tendency to grow slowly, do not metastasize and rarely recur following removal. They vary in size and consistency. In shape they may be spherical, ovoid or irregular, and in number single or multiple. They may be sessile, having a flat base, or pedunculated, having a pedicle.

The word *polyp* or *polypus* is misleading

CLASSIFICATION



believe that various inflammatory conditions of the anorectum irritate these nerve corpuscles and produce the sensation of itching. In a small series of cases studied[17] we were able to demonstrate these myelinated nerve fibers by means of Laidlow's[140] and Davenport's[58] technic. (Fig. 387.)

Symptoms. A crawling sensation in the anal canal or a feeling of incomplete evacuation is usually cited by the patient. Bleeding is uncommon unless the papillae are eroded. Tenesmus frequently occurs from spasm of the sphincter muscles.

Diagnosis. Upon insertion of the gloved finger to the first joint, the papillae may be felt as firm elevations about the circumfer-

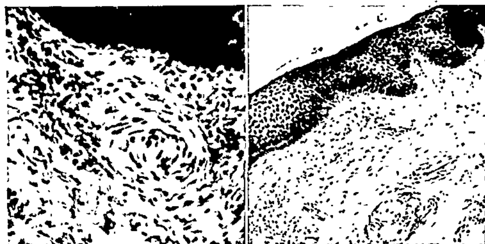


Fig. 386. (*Left*) Meissner tactile corpuscle in tip of papilla. Round-cell infiltration. (*Right*) Meissner tactile corpuscle in papilla.

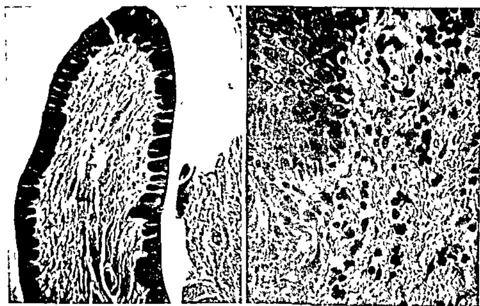


Fig. 387. (*Left*) Section through anal papilla (low power) showing epithelial and interpapillary pegs (Laidlaw's stain). (*Right*) High-power section of anal papilla showing base of an interpapillary peg and the cellular composition of the stroma. Myelinated nerve fibers may be seen in the upper and lower left portions.

and should be omitted from the nomenclature, since it is recognized that this term refers only to form or the shape of a growth. Proper identification, such as adenomatous, papillomatous (papilliferous), or villous polyps should be made when such a tumor is mentioned. Multiple polyposis invariably refers to multiple adenomatous polyps. It should be remembered that any type of tumor may become altered in shape without changing its histologic characteristics. Whereas adenomas and papillomas may originate from mucous membrane, myomas arise from unstriped musculature, fibromas, lipomas and myxomas from areolar tissue and hemangiomas from blood vessels.



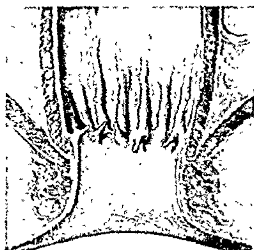


FIG. 384 (*Left*). Sagittal section showing a benign polypoid growth.
FIG. 385 (*Right*). Anal papillae. Coronal section of the rectum and anal canal *showing the teatlike processes originating at the anorectal line.*

EPITHELIAL TUMORS

PAPILLOMA

Without mentioning the possibilities of this variety of tumor, it may be said that papillomata grow characteristically from the surface so that in the anus, rectum and sigmoid two types are encountered, the squamous and the columnar.

Squamous Papillomata. These are not uncommon in and about the anus, although ordinarily they are of little consequence. They are usually flesh colored, single and small. The most frequent variety which may be discussed properly under this heading is the papillofibroma, commonly referred to as hypertrophied anal papilla.

PAPILLOFIBROMATA OR HYPERTROPHIED ANAL PAPILLAE. These are excessive enlargements of the normal anal papillae, from one to eight in number, found at the anorectal line along the border of the semilunar valves and between the columns of Morgagni. (Fig. 385.) They appear as firm, conical or teatlike projections, the tip white and the base pink.

Etiology. Trauma from hard stools and infection appear to be the important causative factors. Cryptitis is frequently associated.

Histopathology. Section reveals a dense and fairly vascular fibrous stroma. The collagen fibrils are unique in their wavy character, while within the fibroblasts the nuclei have a spiral-like structure. The tissue is covered by regular squamous epithelium.

Recently Tucker and Hellwig[274] were attracted by a large number of myelinated nerves running to the tip of the anal papillae and noted the presence of Meissner's tactile corpuscles lying beneath the epithelium. (Fig. 386.) These investigators

cent, gentian violet, 1 per cent, or a concentrated aqueous solution of ichthyol. In every instance the presence of an associated cryptitis should be sought and treated accordingly. Divulsion of the sphincter will offer varying periods of relief, especially when spasm of the sphincter is present; but for permanency of cure the removal of these anal papillae is the procedure to be advocated.

Surgical. If but one papilla is present, an anoscope is introduced and a few minims of procaine, 1 per cent, are injected into its base. The papilla is then excised with scissors or scalpel. The papillotome designed by Hibshman and the author is satisfactory for this purpose. Where several exist, and especially where spastic contraction of the sphincter is associated, block analgesia after the method described on page 963 is recommended. Each papilla is held with hemostats and excised at its base with scissors. The bleeding is usually negligible and controlled readily as the sphincter muscle regains its normal tone. Mineral oil, from ½ to 1 ounce, once daily, topical applications of gentian violet, one per cent, and occasionally hot compresses are continued for a day or so.





Fig. 389. (*Left*) Section through a condyloma acuminatum. An infiltration of inflammatory cells, mostly plasma cells, is seen in the corium. The epithelial layer shows acanthosis and an absence of hyperkeratinization. (*Right*) Polypoid growth of the rectum.

Pseudopapilloma—Condyloma Acuminatum—(Venereal Warts or Verrucae). It may be well to explain at this point that although condyloma acuminatum is not a true neoplasm, it does represent a tumorlike infection of the perianal region. As is customary, therefore, a description of this condition is included here.

Pathology. They arise from the papillary layer of the anal skin and are firm, somewhat fragile, of pale pinkish color and exude an offensive irritating discharge. Occurring as wartlike excrescences scattered here and there about the anal margin, they grow rapidly and tend to encircle the anus or extend along the anterior raphe of the perineum, sometimes involving the scrotum or vulva. (Fig. 388 *Right.*) The condition is more common in men and between the ages of 20 and 30, and especially in the Negro race.

Histopathology. Section shows masses of stratified squamous epithelial cells. (Fig. 389.) The epiderm is greatly thickened with exaggeration of the epithelial pegs and

ence of the anorectal line. Anoscopic examination reveals one or more teatlike projections *extending from the anorectal line* across the line of vision in the instrument. (Fig. 388.) They appear conical in shape with the base reddish pink and the tip white.

Differential Diagnosis. Hypertrophied papillae have been mistaken for small polypoid *growths of the rectum, anal warts,* external thrombotic hemorrhoids and skin tags, but if it is borne in mind that these papillae always originate at the anorectal line, there will result little confusion.

Sequelae. Pruritus ani is of common occurrence.

Treatment. In the course of routine anorectal and sigmoidal investigation, innumerable *patients present one or more anal* papillae of various sizes, and in the absence of symptoms it is unwise to advise their removal. In the presence of distressing complaints, however, excision should be resorted to.

Palliative. Compresses wrung out in hot *boric acid solution and applied locally,* hot sitz baths two or three times daily and instillations of warm olive oil will usually offer temporary relief. In the absence of severe sphincter spasm, a small-sized anoscope may be introduced and the papillae, if eroded, touched with silver nitrate, 10 per





Fig. 388. (*Left*) Anal papillae as seen through the proctoscope showing variation in shape, size and position of the tip. (*Right*) Condylomata acuminata completely encircling the anus.

Table 40. Differential Diagnosis

	Hypertrophied Anal Papilla	Columnar Papilloma (Rectal Polyp)	Condyloma Acuminatum (Anal Wart)	External Thrombotic Hemorrhoid	Skin Tag
Origin	Anorectal line	Rectal mucosa	About anal margin	Below anorectal line	Anal margin
Characteristics	Usually multiple; firm; may be tender to the touch. *Bleeding* is infrequent	Usually single; always pedunculated; not painful unless protruding through anus. Soft; firm; tendency to bleed	Aggregation of pedunculated projections. Excrescence of skin. Usually multiple; seldom bleed	Acute onset; extremely tender; do not bleed	Soft, flabby and *usually* painless. Bleed only if irritated
Covered by	Modified anal skin	Rectal mucosa	Anal skin	Anal skin	Anal skin
Shape	Conical	Globular	Usually coalesce to form large mass	Ovoid	Usually teatlike with broad base
Color	*Pinkish white*	Reddish and glistening	Pinkish with purple tint	Blue	Pale

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Origin	Anorectal line	Rectal mucosa	About anal margin	Below anorectal line	Anal margin
Characteristics	Usually multiple; firm; may be tender to the touch. Bleeding is infrequent	Usually single; always pedunculated; not painful unless protruding through anus. Soft; firm; tendency to bleed	Aggregation of pedunculated projections. Excrescence of skin. Usually multiple; seldom bleed	Acute onset; extremely tender; do not bleed	Soft, flabby and usually painless. Bleed only if irritated
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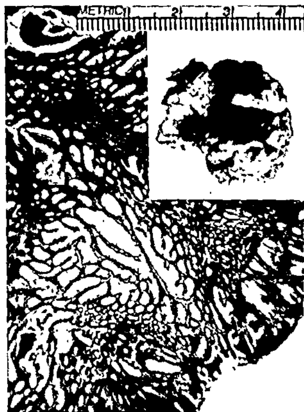


FIG. 390. Insert is of papilloma of rectum removed from a child two years of age; the rest of picture, low magnification showing the loose stroma of the fimbria covered with tall columnar epithelial cells. The arrangement is regular and the basement membrane intact.



FIG. 391. F. D. Villous papilloma undergoing malignant degeneration. Abdominoperineal proctosigmoidectomy performed.

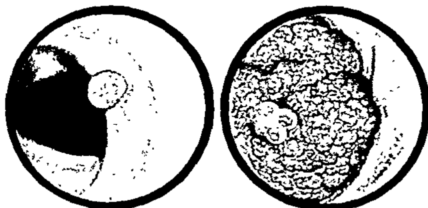


FIG. 392. (*Right*) Proctoscopic view of villous tumor. (*Left*) Adenoma on the middle valve of Houston. Protoscopic view.

the papillae. There is hyperkeratosis and hyalinization of the stratum corneum.

Etiology. Probably the most important causes are irritation from uncleanliness, associated anorectal disease and discharge of anorectal, urethral or vaginal origin.

Symptoms. Although the patient is cognizant of their presence, they cause no pain unless excoriated. The discharge is offensive and irritating to the surrounding skin. Itching of varying intensity is usually an additional complaint.

Diagnosis. The diagnosis of condylomata acuminata is made on the history of the progressive development and the presence of firm, somewhat flattened elevations which are pale pinkish in color and usually painless.

Differential Diagnosis. This condition is to be distinguished from condyloma latum (a manifestation of secondary syphilis) and verrucous tuberculosis. Condyloma latum occurs singly or in groups and appears as a flat, warty elevation having sharply defined edges that rise at right angles to the skin. There is a marked tendency to form large, fungating masses. Ulceration is frequent, the discharge from which is slight in amount and offensive. The Wassermann, Kahn and Kolmer tests are positive. Verrucous tuberculosis begins as a small plaque, wartlike papule or papillary excrescence, scalloped in outline, definitely circumscribed, brownish red in color and mammillated. Occurring at first singly, they gradually increase in size and number. Ulceration takes place occasionally, owing to irritation, and the discharge which exudes is moderate in amount, thick and foul-smelling. The tubercle bacillus may be obtained from the scrapings. Section of tissue shows typical tubercles and the tuberculin test is positive.

Treatment. General. It is essential that the patient cleanse the perianal skin frequently with castile soap and hot water, following which the parts are dried with cotton or some soft material. Toilet paper should be avoided.

Medicinal. Liquid petrolatum, ½ oz. daily, usually will produce soft evacuations. A powder such as aluminum acetate or zinc stearate applied several times daily will keep the parts dry. Excoriations may be treated by curetting the surface with dry gauze and the topical application of silver nitrate, 10 per cent solution, or in stick form; or by using parathiocresol. Cauterization with nitric acid will occasionally decrease the growth if of small size.

During the past few years we have employed podophyllin in several instances with satisfactory results in most cases. Capable of destroying the granulomatous tissue, podophyllin is used topically in a 25 per cent suspension in mineral oil. Excellent results have been reported by Culp[65] and Kaplan.[128] In the presence of recurrence after repeated applications, which frequently are unnecessary, the process may be excised.

Surgical Excision. A sufficient amount of procaine, one per cent, is injected beneath the skin underlying the warty growth, although, if the process is very extensive, caudal or some other anesthetic is to be preferred. The portion of the growth near the skin is held with a hemostat, since the tissue is extremely fragile, and removed in its entirety by means of scissors, scalpel or the surgical diathermy. Ordinarily the bleeding is negligible and can be controlled usually by firm pressure.

Columnar or Mucous Papilloma. This is regarded as a polypoid growth arising from the mucosa of the rectum or sigmoid colon. (Figs. 389 *Right*, 390.) While papillomata should be described apart from the adenomatous variety, both will be discussed under the heading of the latter, since no acceptable hypothesis has been offered, and no distinguishing characteristics have been observed.

Villous Papilloma. This variety of tumor has been comparatively rare in our experience. It is more common in men than in women, and the general age group is between 35 and 55.

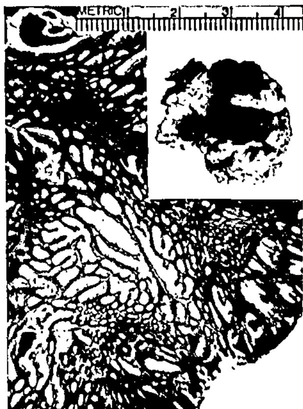


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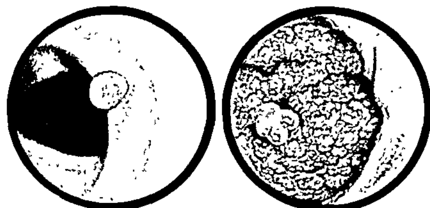


Fig. 392. (*Right*) Proctoscopic view of villous tumor. (*Left*) Adenoma on the middle valve of Houston. Protoscopic view.

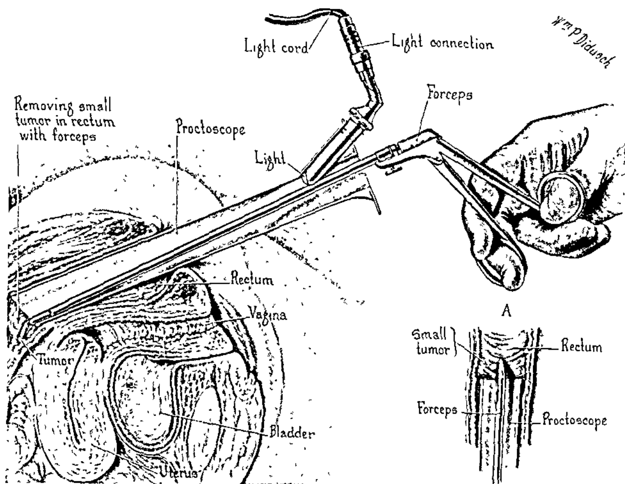


FIG. 393. Turell's biopsy forceps. (Turell: Ann. Surg. 116:637.)

Pathology. This delicate structure arises from the mucosa, apparently from the partitions between the crypts of Lieberkühn, and consists of a large number of villi, or fingerlike projections, joined at their bases. The surface is finely granular. This variety of tumor, which presents a complex aborescent arrangement, appears as a lobulated, spongy mass, reddish or grayish red in color. Although these growths are often sessile, in which case they are called "villous adenomata," *they usually become pedunculated* by dragging down the mucosa. Villous tumors usually occur singly, are of great vascularity and vary in size. They are, however, frequently larger than other varieties and at times attain enormous proportions. They bleed easily, secrete a viscid mucus, and tend to undergo malignant degeneration. (Fig. 391.)

Histopathology. The surface is papillary in appearance and covered by a layer of columnar cells. The connective tissue stroma is vascular and edematous.

Symptoms. The symptoms of villous tumor may be enumerated as follows: (1) frequent passage of excessive, rice-watery or sticky mucus, usually tinged with blood; (2) hemorrhage due to friability of the surface; (3) incomplete evacuations; and (4) pain, usually in the form of tenesmus.

Diagnosis. Digital and proctoscopic examination reveals *a soft, velvety, lobulated* mass, usually of large size. (Fig. 392 *Right.*) The base is not indurated, the surface bleeds readily and is covered by viscid mucus. The finger may be inserted into the mass between the villi. Frequently the growth will protrude through the anus, although the characteristics just enumerated remain unchanged.

Treatment. Inasmuch as these growths

tend to undergo malignant degeneration in approximately 20 per cent of cases,[210] radical excision, as discussed under Malignancy, is the procedure to be advocated. Where the growth presents sufficient length of pedicle and the base can be readily reached through the rectum, either a Bevan excision or removal between clamps with ligation and inversion of the stump may be performed. Such a procedure is contraindicated where the base of the tumor is broad (sessile) and if located above the midrectum. Destruction by the actual cautery, electrofulguration, desiccation and electrolysis are seldom to be recommended.

Adenomatous Polyp

To avoid confusion, the term *adenomatous polyp* is employed to designate either a sessile or pedunculated benign tumor of glandular origin. Many early references to the occurrence of polps of the intestine are to be found in the literature, among which may be mentioned Luschka, Virchow, Wagner and Lebert. Woodward, in 1881, was probably the first to distinguish between true or primary polyps and pseudo- or secondary polyps, which today we consider secondary to an inflammatory condition such as chronic ulcerative colitis. Boas,[33] by the same token, clearly differentiated between isolated papillomas or adenomas and the entity commonly known as polyposis.

Over a period of years innumerable attempts have been made to offer a classification of these growths based on their etiology, histology or behavior, but none has been found acceptable by all groups of investigators.

Description. Adenomas may be single or multiple, sessile or pedunculated, the stalk varying in length to a maximum of several inches. In its incipiency, it presents the appearance of a slight elevation of the mucous membrane, but as growth progresses it presents a rounded surface and may assume a lobular shape.

Incidence. Adenomatous polyps constitute the most common type of benign tumor found in the rectum and sigmoid. The same may be said for the colon proper. The occurrence of these growths from infancy to the octogenarian state is well recognized. Kennedy[134] reported a group of 49 cases ranging from 6 months to 13 years. Yaker[295] and others[72, 73, 148, 203, 216] have cited their experiences.

In 1945, the author[14] reported 29 cases between 14 months and 11 years; 19 were males and 10 females. Twenty-one were visualized sigmoidoscopically and eight by opaque enema with air inflation. Since that time, twelve additional cases have been observed in this span of years; seven were males and five females.

Adenomatous Polyps 14 Months to 11 Years (Author's Series)

Males	26
Females	15
	41

Race and Sex Incidence. Lawrence[149] summarizes his autopsy findings pertaining to race and sex factors as follows:

	No. of Cases	Per Cent of Total	Per Cent of All Autopsies for This Sex and Race	Average Age in Years
White male	110	66.2	3.93	59.09
White female	26	15.6	1.9	58 6
Colored male	17	10.2	1.0	56.3
Colored female	13	7.8	1.12	48.8

The incidence of benign polypoid lesions abridged from Berk, to which additional references have been added, is appended in the table on the following page.

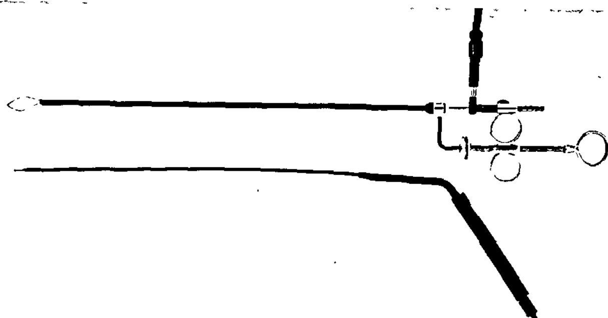


FIG. 394. (*Upper*) Electric snare. (*Lower*) Coagulating electrode, long.

TABLE 41

AUTHOR	YEAR	NO. AUTOPSIES	MATERIAL SELECTED	PER CENT POLYPS FOUND
Mayo, C. W.[175]	1942	100		16
Stewart[253]	1931	1815		4.19
Lawrence[149]	1936	7000	Consecutive autopsies	2.37
Felsen[84]	1941	955	All ages	6.4
Susman[263]	1932	1100	Necropsies	6 0
Atwater, *et al.*[10]	1945	241		69
Hellwig[108]	*1947*	*1460*	Consecutive autopsies	*9.5*
Klemperer[136]	1938	. .	Routine autopsies	21
Feyrter[85]	1931	1800	Consecutive autopsies	21.4
Swinton and Haug[266]	*1947*	*1843*	Consecutive autopsies	*7*
Strauss[259]	1932	7000	Autopsies	1.7

It is of interest to mention that of the 100 cases reported by Mayo, in which 16 or 16 per cent showed polyps, 8, or 50 per cent, of these 16 disclosed malignant change.

INCIDENCE OF ADENOMATOUS POLYPS BY SIGMOIDOSCOPY

AUTHOR	PER CENT INCIDENCE
Martin[165]	4.43
Buie[43]	2.5
Thiele[268]	1.2
Brust[42]	*5*
Phillips[211]	5

Location. The rectum, rectosigmoid and sigmoid are the most common sites involved. Such has been our experience and it coincides with the observations of others.[34, 72, 220] Martin[165] has tabulated the location as follows:

LOCATION	NO. CASES	PERCENTAGE
Rectum	33	52.4
Rectosigmoid	21	33.4
Sigmoid	10	15.9
Whole colon	*5*	*7.9*

In a series of 143 cases of solitary adenomata, Buie and Brust[44] found 47.5 per cent located in the upper rectum and rectosigmoid. Coffey[56] noted that 43 per cent were situated on the anterior wall. Swinton

and Warren,[214] in a group of 156 cases, found 70 per cent to be visible with a 10-inch sigmoidoscope.

Etiology. This subject has been discussed at some length under Malignancy (see Chap. 19, p. 614) and does not bear repetition. Suffice it to state there are divergent views concerning the origin of true adenomatous polyps.

Additional causes to be mentioned are allergic change,[233] simple hyperplasia of the colonic mucosa[10] and traction on small protuberances of mucosa.[114] Preceding changes in the subepithelial tissue have been noted by Bargen,[21] Knoflach[138] and Mayo.[172] Aggregations of lymphocytes may occur, possibly as perivascular infiltrations, and may assume the histologic appearance of a lymph follicle. Changes occur secondarily in the overlying epithelium, consisting of irregular proliferation of the glandular structures. Following rupture of the follicles, one of several processes may ensue: (1) the epithelium may prolapse into the cavity in the submucosa; (2) at the point of rupture into the intestinal lumen ulceration may occur which, in healing, may trap atypical cells in the depths of the ulcer; (3) enlargement of a circle of follicles may isolate an area of epithelium, with subsequent hyperplasia of atypical glandular structures in the isolated fragment.

Heredofamilial Tendency. This etiologic factor will be discussed later in the chapter under the topic Multiple Polyposis.

Chronic irritation and inflammation have been described as precursors of polyp formation. Included in these factors are chronic ulcerative colitis, dysentery infection, bilharzia infestation[78] and the ova of various parasites such as *Oxyuris vermicularis*.

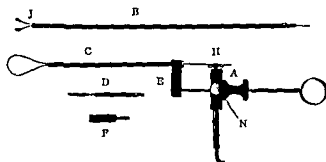


Fig. 395. (A) Sliding knobbed unit. (B), (C) and (D) 12-, 6- and 3-inch shafts. (F) Adapter for shafts. (H) Circular nut for securing snare and biopsy wires. (N) Set screw for sliding unit. (J) Biopsy cups. (Gorsch, R. V.: Am. J. Surg. 35:617.)

Additional reports have been cited.[23, 122, 171, 230, 233, 271] Browne[39] has listed 130 instances of colonic lipomata from the English literature. The consensus seems to be that the mucosal cells lining the colon undergo proliferative changes, with the exact stimulus undetermined. When this proliferation is under way, the rate of growth is variable, as is the degree of change from the normal. Individual factors inherent in different persons then determine whether the new growth shall be a simple hyperplasia or shall progress to irregular disorderly arrangement of cells and thence to malignant characteristics.

This variety of changes may be found microscopically in many adenomata, so that some authors[10, 44, 50, 287] stress the probability that an adenoma is but a stage in the development of malignancy.

Pathology. An adenoma is a benign epithelial tumor possessing a glandular structure, connective tissue stroma and muscular layer, however sparse. It does not invade the wall of the bowel in its benign state, but

protrudes into the lumen. Its base may be broad (sessile) or in the form of a pedicle (pedunculated). These growths may arise from the flat surface of the mucosa or from the summits of the folds. Their size is quite variable, while the shape may be regular or lobulated.



Fig. 396. Benign adenoma. Longitudinal section through a benign adenoma of the rectum (low power) showing fimbria covering the surface and the body of the tumor. It is made up of elongated acini showing a benign type of epithelium. The characteristic picture of malignancy is lacking.

Swinton and Warren,[267] as well as Hellwig,[108] have called attention to the presence of numerous individual stalks supporting the closely approximated polypoid projections even in the sessile forms. The color varies from a gray to a rich red, and in many instances, when of small size, there is little change from the normal. Because of traction by feces, which is presumably an elongating factor, erosion and ulceration are not uncommon.

Histopathology. An untraumatized adenoma is a tumor consisting of a connective tissue stalk surfaced by columnar epithelium. The stalk originates from the submucosa, usually possesses a muscularis mucosa continuous with that of the intestinal wall and bears the blood vessels. The stalk may be single or multiple, straight or with a treelike branching effect. Connective tissue with variations in the degree of cellularity and strands of smooth muscle are in evidence. More often the stroma is dense and hyalinized. The degree of vascularity is variable especially in the older processes and it is not uncommon to observe occlusion by thrombi. The connective tissue stalks are covered by regularly arranged columnar epithelium in the form of glands which vary somewhat in size and contour. Usually the cells are of the tall columnar variety with nuclei moderately chromatic. Mitotic figures are frequently encountered in some adenomas but are absent in others. Helwig[107] observed inflammatory cells, especially in the larger adenomas, such as lymphocytes, plasma cells, monocytes and neutrophilic and eosinophilic polymorphonuclear leukocytes. Such were not described in the investigations of Swinton and Warren. Irrespective of these findings, the conclusion can be drawn that adenomas of the large bowel are true tumors and are not the result of a diffuse inflammatory process.

Westhues[287] has described a detailed study of the histopathology of these adenomata which is of interest. He classifies the true adenomata as follows:

Group I: Benign undedifferentiated polyps. They are undistinguishable in their early stages from simple hyperplasia either macroscopically or microscopically. They do not become larger than cherry or walnut size. Malignancy does not develop in this group.

Group II: Relatively benign or malignant dedifferentiated polyps with an organoid structure, and later with very regularly beginning carcinomatous degeneration. These growths may attain relatively large size over a period of years.

Fig. 397. (Gorsch, R. V.: Tr. Am. Proct. Soc. 1940, p. 272.)

Group III: Particularly malignant polyps with disorderly structure and very early carcinomatous degeneration. They are almost always caricatures of polyps of Group II.

Symptoms. There are no characteristic symptoms of adenomatous polyps. In a group of 391 cases reported by Broad and the author,[16] 63 per cent offered no complaint referable to the benign growths which were found on routine examination. Not infrequently the symptoms are determined somewhat by the size and location of the tumor. Bleeding is the most common complaint. It may vary in amount but is usually bright red in color. An incidence of 50 per cent is reported by Swinton and Warren.[267] Constipation and a sense of weight or pressure in the rectum may be cited where the growth has attained considerable size. Straining at stool is frequent when the mass is located in the lower rectum or is carried along the stool to impinge upon the sphincters. In some instances the patient may mention protrusion of the growth through the anus. In such, pedunculation is not uncommon.

Diagnosis. A history of bleeding in an individual should arouse a suspicion of a malignant process until proved otherwise. On digital examination an adenomatous polyp may be revealed as a smooth, slippery tumor, moderately elastic, lobular in shape and without induration of its base. On



Fig. 398. Long Jackson biopsy forceps (50 cm.).

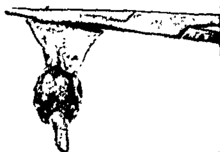


FIG. 399. Adenomatous polyp removed by sigmoidotomy.

proctosigmoidoscopy a glistening growth of similar form, pale pink to red in color and covered by mucous membrane is presented. A small adenoma may be only a slight elevation of the mucosa, usually well circumscribed.

In the vast majority of instances little difficulty will be encountered in distinguishing between a benign and a malignant process. There does occur an occasional case, however, that will tax the ingenuity of the most expert, and one should never hesitate to resort to histologic study for confirmation. Therefore, the only conclusive method of differentiating between a benign adenoma and a malignant adenoma is by histologic study, and even this method has its limitations. It should be further emphasized that a negative biopsy report or even a succession of negative reports does not preclude the possibility of malignant degeneration in another area of the polyp. Thus, it is recommended that adenomas removed should be submitted to serial section.

Roentgenologic examination employing the double-contrast method is of utmost value and should be required in all cases, even though a single adenomatous polyp may be visualized sigmoidoscopically. The reduction density opaque technic devised by Henderson[100] has been especially helpful in the demonstration of these tumors.

Differential Diagnosis. Adenomata of the rectum are to be distinguished from internal hemorrhoids, villous papillomata, mucous prolapse, procidentia and carcinoma, the features of which are shown in the appended table.

TABLE 42. DIFFERENTIAL DIAGNOSIS OF BENIGN TUMORS

	Adenoma	Villous Papilloma	Internal Hemorrhoids	Mucous Prolapse	Procidentia	Carcinoma
Age	Any age	35-55	20-50	More common in children	Usually adults	35-60
Characteristics	Smooth, shiny, firm, globular mass; red in color; single or multiple; sessile or pedunculated; varying from size of match head to hen's egg. Tend to bleed and undergo malignant degeneration	Rare; single; globular in shape; soft; spongy; red in color; usually of very large size. Projecting villi; constantly secretes viscid mucus. Tends to undergo malignant degeneration	Located in lower rectum above anorectal line; ovoid in shape; soft in consistency; red or reddish purple in color; one to four in number	Soft and firm; abnormal looseness or wrinkled swelling of mucosa involving part or all of the circumference. By the finger a sulcus is noted between the outer surface of the prolapse and the intact wall. If protrusion occurs through the anus it appears as a single spherical mass, smooth, with longitudinal furrows radiating from anus	Is thick, movable and slippery; involves entire circumference of rectum. Finger can be insinuated between outer surface of procidentia and intact rectal wall. If it protrudes through anus, it appears as a series of circumferential folds	Nodular mass; irregular in outline; firm and fixed. Large, craterlike ulcer forms. Biopsy of tissue positive

Malignant Degeneration of Adenomas. The importance of adenomas of the colon and rectum lies in the fact that these tumors bear a definite relation to malignancy. Medical literature contains abundant evidence indicating the degeneration of benign into malignant polyps, the association of frank carcinomas with polyps in the vicinity, a histologic pattern in some carcinomas suggesting their derivation from adenomatous polyps and observations of undisturbed polyps evolving into carcinomas at the same site years later.

More than fifty years ago Michelson[183] described the occurrence of a secondary cancerous process, while Gordon-Watson[91] and Thompson[269] have given impetus to such a possibility. The correlation between adenomatous polyps and malignancy is so significant that some authors, including Schmieden,[235] Fitzgibbon and Rankin,[87] consider it to be very plausible that the histogenesis of carcinoma of the colon is a development of precancerous polyp formation and not otherwise. Lockhart-Mummery and Dukes[79] likewise believe that simple adenomata, whether of the single or multiple variety, eventually show malignant characteristics, and they consider adenomata merely a stage in the development of malignancy.

Numerous authors have attested to the frequency with which polyps are found in the vicinity of the carcinoma. In specimens of colon removed surgically for carcinoma, examination disclosed the presence of small sessile outgrowths for a distance of at least 15 cm. from the margin of the carcinoma or to the end of the specimen. An average of from three to four such growths per specimen was observed by Westhues.[287] Berson and Berger,[31] reviewing 344 cases of cancer of the large intestine, found multiple cancers in 16. Of this number 6 had coexisting polyps, an incidence of 37.6 per cent.

The high incidence of proven malignancy in polyps is extremely significant, as shown by the reports of various investigators. Our own group of cases, reported by Dr. George Broad and the writer,[15, 16] consists of 171 consecutive specimens of rectum and sigmoid. In addition to the primary cancerous growth for which resection was performed, adenomatous polyps were present in the specimen in 54 instances, an incidence of 31.2 per cent. Of this number 11 or 20.3 per cent were malignant.

Complications and Sequela of This and Other Benign Tumors. Besides malignant change, complications of these benign tumors, hemorrhage, intussusception, intercurrent infection, occlusion of the rectum or colon and compression of contiguous organs because of their large size may supervene.

Prognosis. The prognosis of simple adenomata depends on early detection and

TABLE 43

Author	Year	No Cases Carcinoma	Site of Carcinoma	Per Cent with Polyps	Per Cent Malignant
Cain and Bensaude[10]	1937	95	Rectum	28.4	
Dukes[77] .	1926	33	Rectum and sigmoid	76	
Klemperer[136] . .	1938	103	Colon	17.5	
Lawrence[149] . .	1936	95	Colon and rectum	23.1	6.5
Susman[263] .	1932	34	Colon	44.1	
Stewart[253] . .	1931	79	Colon	26.6	
Mayo, C. W.[173] .	1942	334	Colon and rectum	34.1	14
Westhues[287]	1934	28	Colon and rectum	57.1	
Coller, *et al.*[58] . .	1940	53	Rectum	41.5	
Yeomans[296] . . .	1937	171	Rectum and sigmoid	4.7	
David[71] .		128	Rectum and sigmoid	31.2 } small 13 } large	8.9
Bacon and Broad[15, 16]	1947	171	Rectum and sigmoid	31.2	20.3

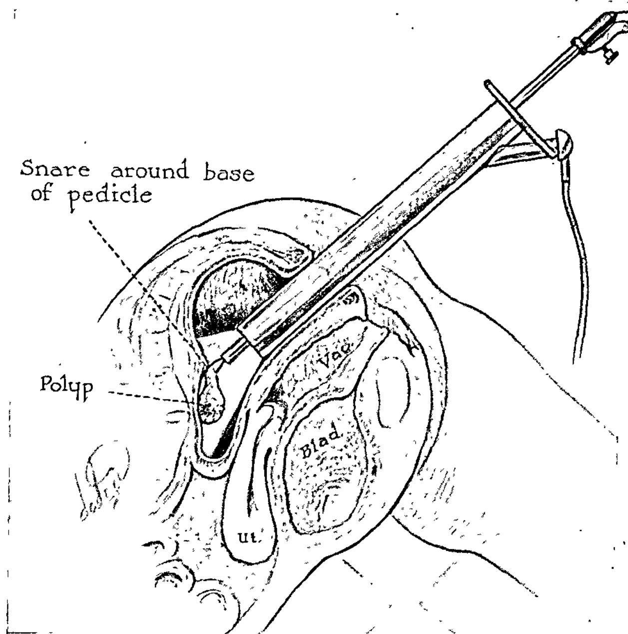


FIG. 400. Removal of polypoid growth through sigmoidoscope by electric snare.

destruction. Furthermore, it is of utmost *importance that these patients return periodically every few months for re-examination, so that any secondary growth may be* detected. Lockhart-Mummery[157] expresses *this thought as follows:* "*The patient is by* no means cured by the removal of the *adenoma, however completely its removal is* carried out . . . it is probably true that the particular adenoma which has been removed will not return, but the changes in the epithelial cells which have resulted in the formation of the adenomatous tumor *may still be present, and other adenomatous* tumors are liable to form in the neighbor*ing epithelium.*"

Treatment. As stated previously, when *an adenoma is discovered during a routine* sigmoidoscopic examination, radiologic ex*amination of the entire colon is indicated* to ascertain the presence of additional lesions. Attempts should be made to obtain histories and examinations of siblings and parents. Eradication of the lesion is in order



Fig. 401. A. J., age 55. Opaque enema study showing growth in sigmoid. Process removed by segmental resection (Benign growth.)



Fig. 402. G. M., age 52. Roentgenographic study following barium enema with an inflation revealed an irregular mass approximately 3 cm. in diameter, location in the midsigmoid. A negative shadow measuring 5 mm. in width × 15 mm. in length is believed to represent a pedicle. The appearance of the mass and pedicle indicates that this is most likely a polypoid growth. Resection performed with immediate closure.

and wherever possible, serial section of the polyp.

Small pedunculated lesions situated below the peritoneal reflection may be treated by ligation of the pedicle close to the bowel wall and excision of the tumor distal to the ligature. If the pedicle is broad, it should be doubly transfixed to prevent the ligature from slipping before excision of the polyp. A satisfactory method for small, pedunculated, accessible tumors is removal with the fulgurating snare. Adenomata below the peritoneal reflection are usually amenable to unipolar or bipolar fulguration. Tumors of the rectum may lend themselves in some instances to local excision after the method of Bevan, as described under Malignancy, Chapter 19. David[71] and Keller[133] have also presented similar procedures. Other methods, such as electrolysis and removal by the actual cautery, have been recommended. Above the peritoneal reflection an adenoma may be accessible through the sigmoidoscope for cautious fulguration. It is important to realize that vigorous traction or manipulation at the base of a pedicle may result in a tear or slough with perforation through the peritoneal coat. Hemorrhage is an undesirable feature. In our department an adenoma on the posterior wall above the peritoneal reflection is destroyed by fulguration, if of small size. A small adenoma or polypoid process in the low sigmoid and on the anterior or anterolateral wall is similarly destroyed, provided the patient is hospitalized. When adenomatous polyps are indeterminate or appear the least suspicious and the histologic reports are inconclusive, for locations above the lower sigmoid the approach is made through the abdomen. The technic is described as follows.

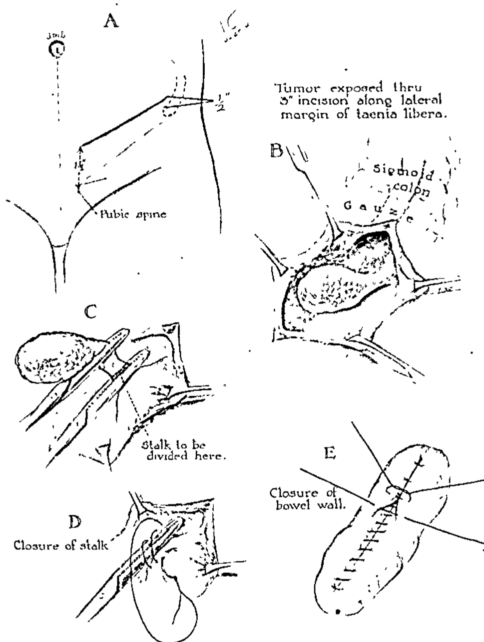


FIG. 403. Technic of sigmoidotomy.

SIGMOIDOTOMY. *Technic*. Under spinal analgesia, the abdomen is opened through a left diagonal or Babcock incision and the small bowel held aside with hot packs. The sigmoid is carefully palpated for the growth and when found the bowel above and below is held taut and gently pinched. Hot towels or packs are employed to isolate the site of incision. An incision is made vertically through the longitudinal band, and, as the lumen of the bowel is opened, suction is applied to remove liquid contents that may be present.

Where the growth is pedunculated, the base is doubly clamped and divided and the base inverted by one layer of suture interruptedly placed. A sterile sigmoidoscope is inserted above and below to determine if additional processes are present. If so, the incision is extended to the site desired. Closure of the lumen is effected by introducing a continuous suture of fine catgut

through all layers. Interrupted Lembert sutures of fine silk are inserted through the serosa and the suture line protected by stitching fat tabs thereover. Sulfathiazole powder, 2½ Gm., is sprinkled over the bowel, and the packs are removed. Routinely, a Babcock sump drain is inserted into the pelvis for from 24 to 48 hours. Of recent date, we have used one gram of streptomycin and 100,000 units of penicillin intraperitoneally, in which case sump drainage is omitted. In some instances we have administered the penicillin (100,000 units) and streptomycin (1 Gm. in one liter of normal saline solution) into the sump drain by the drip method (40 drops per minute) every 12 hours. Finally, the abdomen is closed using figure-8 alloy steel wire No. 32 gauge with No. 35 for skin.

Where the growth is sessile, frozen section is made, and, while the report of the laboratory is awaited, additional visualization through the sigmoidoscope is performed. If the report is benign, wide excision of the area is made and the defect closed in layers. If the report is malignant, segmental resection is indicated. Once the lumen of the bowel is open, it is foolish to close and then resect, for which reason we *extend the excision to include a wide portion* of the mesosigmoid and adjacent bowel and either (1) exteriorize (modified Mikulicz-Rankin, see p. 809, Malignancy, Chap. 19) or (2) openly anastomose the segments. The technic is similar to the description on page 819 (see Malignancy, Sigmoidectomy). Our results with sigmoidotomy have been quite satisfactory, although in our group of 53 cases there were two deaths during 1943 due to pulmonary embolism. The mortality, therefore, in our series is higher than has been reported by others, as shown in the following table.

Transcolonic Removal of Polyps

Author	No. Cases	Per Cent Showing Malignancy	No. Deaths	Per Cent Mortality Rates
Mayo and Smith[178]	62	62.9	2	3.2
Cattell and Swinton[50, 265]	41	24.3	0	2.4
David[70]	20		0	0
Bacon[17]	53	50 9	2	3.7

Lymphadenoma. Instances of this variety of tumor involving the rectum are few.[29, 81, 74, 140, 151, 214] Hayes *et al.*[103] collected 20 cases from the literature. Like adenomata in general, they occur in adults as well as in children.[51, 104]

Pathology. Lymphadenomata are present as nodes in the submucosa and are covered by mucous membrane. They may be sessile or pedunculated. The structure is similar to that of a lymph node, consisting of aggregations of hyperplastic cells with follicles and germ centers in a stroma of connective tissue. Two forms have been distinguished, the circumscribed, which consists of solitary vegetations in the rectal lumen showing a tendency to circular involvement and subsequent narrowing, and the diffuse polyadenomatous, which consists of multiple polypoid growths.[81]

Smith[248] reported three cases of lymphoid tumor which had been diagnosed as internal hemorrhoids. The only gross finding to distinguish from other disease rather than simple varicosity was palpable induration in freely movable areas. Microscopy showed *lymphosarcoma in* one case and benign lymphoma in the remaining 2 instances. The case cited by Hayes, Burr and Pruitt[103] concerned a patient with multiple small polypoid tumors scattered throughout the transverse colon and included the rectum. The histologic report was lymphoid tumors. Those which could not be reached by fulguration were treated by irradiation. Resection has also been advocated in these cases.

In a recent case the author was unable

to establish a diagnosis of a hard, fixed, rounded mass in the posterior rectal wall in the region of the sacral hollow. An abdominoperineal proctosigmoidectomy was performed without colostomy and with preservation of the sphincter muscles. The plum-sized growth was reported as a "benign lymphoma."

Agminated Adenomata—Multiple Polyposis

This disease entity parades under a variety of names such as disseminated adenomata,[60] multiple adenomata,[289] colitis polyposa,[282] polyposis, polyposis intestinalis,[101] and adenomatosis,[155] which, although of rare occurrence, is encountered with greater frequency as a result of routine sigmoidoscopic examination and improvement in roentgenologic technic.

Incidence. The disease is usually seen in early adult life. A review of 40 cases reported by Doering[73] shows the age as follows:

Age	No. of Cases
1-10	2
10-20	10
20-30	10
30-40	13
40-50	2
50-60	2
60-70	1
Total	40

Other cases occurring at a very early age have been reported.[32, 134, 197, 240, 277] Atwater[10] observed that approximately two thirds of their cases occurred under the age of thirty. As to sex, the majority of patients afflicted with the disease are males,[193] in the proportion of three to one.[249]

Etiology. Many hypotheses have been advanced in an effort to explain the presence of these adenomas, but none has proved satisfactory for all cases. Probably the most important theory is that advanced so ably by Lockhart-Mummery,[156] which assumes them to be due to a gene mutation inherited as a Mendelian dominant. This means that, while children are not born with the disease, they inherit the susceptibility of the epithelial cells to proliferate at puberty or in early adult life. Coffey and Bargen[56] observed a heredofamilial disposition in 34.5 per cent of the cases, while Dukes *et al.*[158] have given charts of seven families in which various generations have produced cases of multiple polyposis, and five other families had carcinoma of the bowel associated with the adenomata. Lahey[145] agrees that there is a diathesis in certain families in which more than one case of multiple polyposis exists. That there occurs a familial tendency is discussed by others.[7, 32, 77, 78, 83, 96, 111, 113, 116, 120, 152, 178, 180, 190, 197, 207, 209, 228, 256, 260, 280, 303, 304, 305, 306]

There are those who believe that this condition is the result of some congenital defect in the intestinal wall,[194] but such does not explain the multiplicity of tumors or the usual confinement to the rectum and sigmoid colon. It has been suggested, too, that some form of irritation is the cause of secondary polypi.[82] Several investigators[112, 247, 288] are of the opinion that chronic ulcerative colitis plays an important role, and in support of this Bargen[22] has published a report stating the incidence of polyposis as 10 per cent in a large series of cases.

It is the belief of Coffey and Bargen that, since 21.9 per cent of their cases of multiple adenomata associated with ulcerative colitis were of the true tumor type, and 56.2 per cent were pseudo-adenomatous, such factors should carry considerable weight in any consideration of the etiology. Swinton and Warren,[287] on the other hand, find that the adenomata associated with chronic ulcerative colitis are not true adenomata but are rather areas showing "atrophy of the mucosa and varying degrees of chronic inflammatory reaction, often with fibrosis —a marked contradistinction to the neoplastic type of polyp." Hellwig[107] too concurs with this opinion. Wesson[284] divides these multiple polypoid growths into (1) postinflammatory polyps and (2) true polyps. Other investigators consider dysen-

teric[97, 287] and bilharzic[180] infections etiologic factors.

Our experience has been limited to 16 patients with true polyposis. The age and sex incidence are shown as follows:

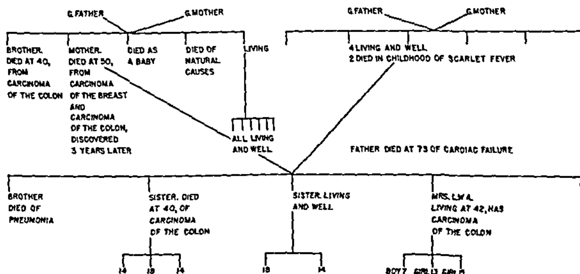
No. Cases	Age	Sex	Incidence of Malignancy	
1	8	F	0	
2	15	F	+	
3	24	M	0	
4	24	M	0	
5	28	M	+	
6	29	M	+	
7	29	M	+	
8	29	M	0	62.5% malignant
9	31	M	0	
10	32	M	+	
11	42	F	+	
12	56	M	+	
13	47	F	0	
14	24	M	+	
15	44	M	+	
16	60	M	+	



Fig. 404. Polyposis.

Case No. 11 is interesting. The patient, Mrs. L. W. A., age 42, was examined by Dr. Chesterfield Holley of Wheeling, West Virginia, who made the diagnosis of adenocarcinoma, grade II, superimposed on multiple polyposis.

This patient was referred to us in March, 1945, and examination disclosed the adenomatous polyps in the sigmoid, descending colon and splenic flexure. Because the patient refused any form of colostomy, the author performed a left hemicolectomy and proctosigmoidectomy with transplantation of the transverse colon to the anus as a one-stage procedure. One additional polyp showed malignancy. The patient made an uneventful recovery and was discharged from the hospital on her thirteenth postoperative day. The sphincter has been continent and there was no evidence of recur-



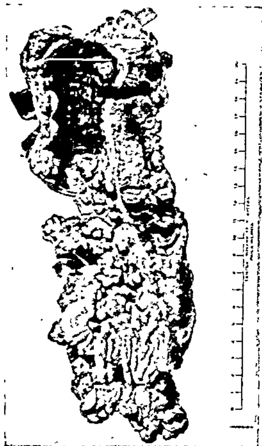


FIG. 405. Polyposis of the rectum and lower sigmoid. Removed by Lahey method. (J. C. Howell and the author.)

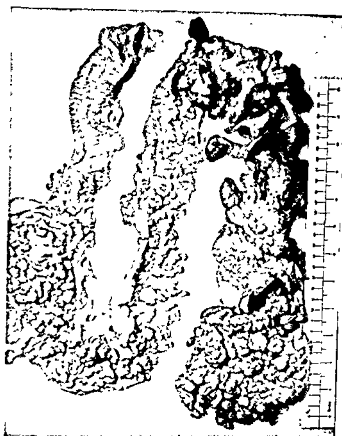


FIG. 407. Polyposis. Gross specimen showing intensive involvement from the ileocecal valve to the anorectal line. Arrow pointing to area having undergone malignant degeneration.

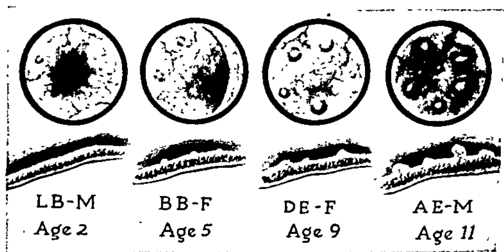


FIG. 406. Comparative size of adenomas in four children of one family, ages 2, 5, 9 and 11. As there is an average difference of two years and nine months in the ages and so nearly a like amount of growth for each period, it suggests congenital origin in the 2-year-old and hence in all. (D. C. McKenney, J.A.M.A.)

rence when last seen by Dr. Holley, August, 1948. (See history chart, p. 561.)

PATHOLOGY. These growths may be sessile or pedunculated. (Fig. 405.) They vary greatly in size, contour, consistency, number, and area of bowel involvement. (Fig. 404.) The size, which depends to a great extent on the stage of development, ranges from a match head to a walnut or larger. Ordinarily they are ovoid in shape, red or reddish purple in color and soft. In some cases a few tumors will be noted, whereas in others dozens or even myriads may be found. The disease may be confined to a small area or it may involve the entire colon from the cecum to the anus. To indicate studding of the entire inner surface of the large bowel with convoluted polyplike elevations, the term "polypoidosis" has been coined. The most common sites of these growths are the sigmoid and rectum.[218] The latter, according to David,[70] is involved in 95 per cent of the cases. So far as the malignancy index is concerned, it has been estimated that 50[92] and even 60[284] per cent undergo carcinomatous change. (Fig. 407.)

Westhues[287] has made the following conclusion, "We know beyond contradiction that carcinomatous degeneration actually occurs in 50 to 100 per cent of all cases." Fitzgibbon[57] has expressed the opinion that all cases of carcinoma develop from a polyp. There does exist, however very definite evidence that carcinoma may arise directly from the mucous membrane. Examples have been clearly demonstrated by



FIG. 408. Section taken through the tip of a polyp showing hyperplastic epithelium covering fimbria of corium which are infiltrated with chronic inflammatory cells, the majority of which are plasma cells.





FIG. 409. (*Left*) The filling defects in the rectum are produced by the multiple polyps which project into the lumen. In contrast, as shown on right, multiple diverticulae of the descending colon and sigmoid. Note marked irregularity and narrowing of the bowel.

Hellwig.[108] In our group of 16 cases, 10, or 62.5 per cent, were malignant.

HISTOPATHOLOGY. These growths are lined with columnar epithelium of the goblet type. The glands, which stain deeply, are somewhat larger than normal and are embedded in a connective tissue stroma in which there is a varying degree of inflammatory reaction. Small round-cell infiltration is noted. The amount of fibrosis present varies in different specimens. (Fig. 408.)

To determine the presence of carcinoma arising in an adenoma, Swinton and Warren[267] advise that at least two of the following criteria must be present: (1) anaplasia, (2) irregularity of architecture and (3) invasion.

SYMPTOMS. In each case the symptoms are in direct proportion to the location and extent of development. Diarrhea is the most constant symptom, although constipation may be cited. The stools are more or less liquid, yellow, frothy and very fetid. Usually the patient describes the occurrence of frequent evacuations accompanied by pus, mucus and blood. Abdominal pain, colicky in type, and tenesmus soon develop and are followed by weakness and loss of weight.

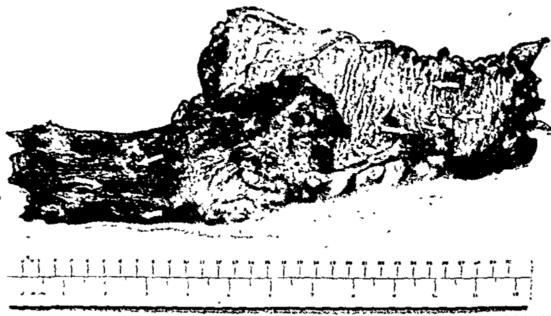


FIG. 410. T. McC. Adenocarcinoma of rectum, Grade II. Arrows point to additional lesions.

DIAGNOSIS. Attention has been drawn to the intestinal tract by the symptomatology described. In the majority of instances multiple polyps may be visualized through the sigmoidoscope, since the rectum and sigmoid are the most frequent site. Adenomatous polyps usually appear as soft, rounded projections, varying in size, shape and number. Histologic examination should be made in all cases. Radiologic studies of the entire colon employing the double-contrast technic is of inestimable value. It should be routine for all patients. Scheltel[234] has called attention to the incidence of eosinophilia, although in our small group of cases such has not been confirmed.

DIFFERENTIAL DIAGNOSIS. Polyposis is to be distinguished from carcinoma, chronic ulcerative proctocolitis, diverticulitis and endometriosis as shown in Table 44, page 565.

COMPLICATIONS AND SEQUELAE. Malignant degeneration, intestinal obstruction, intus-

TABLE 44. DIFFERENTIAL DIAGNOSIS

	POLYPOSIS	CARCINOMA	CHRONIC ULCERATIVE PROCTOCOLITIS	DIVERTICULITIS	ENDOMETRIOSIS OF THE RECTUM AND SIGMOID
Age	15-35	40-60	20-40	50-60	25-45
Sex	Males	Males	Males	Males	Only females
Characteristics	Multiple sessile and pedunculated growths that are movable, elastic, shiny and reddish purple. Fever may be present	Single, irregular, nodular mass with firm, broad base, indurated and fixed. Enlarges and becomes fungating. Ulcer is craterlike with raised everted edges. Is malignant and metastasizes	Minute yellow abscesses beneath mucosa which break down to form numerous ulcers of small size with moth-eaten appearance. Surrounding mucosa diffusely inflamed and granular. Fever	Numerous hernial protrusions or sacs; nubbin-shaped, sometimes elongated and soft. Ulceration infrequent. Increase in temperature	Physiologic response during menstruation. Occurs as one or more nodules in rectovaginal septum, anterior wall of rectum or sigmoid Varies in size from buckshot to a cherry; overlying mucosa not involved Not malignant but does metastasize Rarely ulcerates
Roentgen ray study	Visualized as multiple rounded projections in the intestinal lumen	Filling defect in sigmoid or upper rectum, depending on site of growth	Hypermotility, contour smooth with loss of haustrations. Occasionally appears feathery or fringed	May show diverticulae of sigmoid, especially following double contrast enema	Usually negative
Laboratory	Biopsy shows benign growth	Malignant growth	Diplostreptococci may be isolated from bases of rectal ulcers		Section shows endometrial tissue

susception, hemorrhage and intercurrent infection may occur. It has been mentioned[28] that the evolution of polyposis is fatal, death supervening most frequently between 6 and 12 years after the first manifestations.

TREATMENT. Where the disease process is confined to the rectum and lower sigmoid, destruction or removal should be instituted by electrofulguration using the electric wire snare or rounded electrode tip. Before treatment is begun, complete and thorough examination of the colon should be made by a competent radiologist using the double-contrast method. Where the results are indeterminate or the least suspicious, the study should be repeated. It may be mentioned that irradiation therapy has been recommended,[11, 179, 278] an opinion with which the author cannot concur. Appendicostomy, ileostomy, cecostomy and colostomy comprise the nonradical palliative measures and are of value only in that they place the bowel at rest. Radical surgical excision is the accepted approach. In three of our cases, a left hemicolectomy and proctosigmoidectomy with transplantation of the transverse colon to the anus and without sacrifice of the sphincter muscle was satisfactorily effected. One is here reported in brief.

Case No. 118647 T.U.H.: W. C. B., a 32-year-old white male, was referred on September 16, 1946, because of passage of blood and mucus with stool, and occasional diarrhea, of four years duration (no family history of cancer or bowel disease). Passage of blood was the initial symptom. Diarrhea in its early phase was attributed to infected drinking water. At first only small amounts of blood were noted at intervals.

One and a half years previously, the patient was examined in another city. Rectal examination disclosed a number of small polyps in the upper rectum. Re-examination was made 15 months later, when sigmoidoscopic examination showed many adenomatous polyps in rectum and sigmoid. Biopsy revealed "adenomatous polyposis with extensive active proliferation of glandular cells." Later 22 small polyps in the rectum and lower sigmoid were destroyed by fulguration. Barium

enema study followed by air inflation was reported negative. Repetition of this procedure and later removal of the sigmoid was advised. The patient refused a colostomy and consulted his uncle, an eminent surgeon in a distant city.

When examined by the author, the mucous membrane of the rectum and sigmoid showed much scarring. Present were many polypi of varying sizes and shapes. The growths in the upper bowel gave no evidence of treatment. Many in the rectum had been destroyed, while others appeared to have recurred.

The patient was hospitalized for study. It was particularly desirable to know how far these polyps extended into the colon. A barium enema on 9-19-46 showed normal colonic contours and haustrations throughout and normal caliber. After air insufflation, stereoscopic films were made. The report stated, "No evidence of polyps on these studies." This radiologic experience demonstrates how difficult it may be to obtain verification of small growths by this means, even when great care is taken. Blood chemistry studies and general physical examination were essentially normal, except for a firm, small growth attached to the ramus of the right mandible, unrelated to the present illness.

Operation. A left colectomy and abdominoperineal proctosigmoidectomy were performed on 10-3-46 under fractional spinal anesthesia. The initial manual abdominal exploration revealed a normal liver; suspicious areas of polypi were palpable in the upper descending and sigmoid colon. The sigmoid was freed laterally, as was the descending colon up to and including the splenic flexure, which was exposed and freed. Care was taken to preserve the vascular arcades to the colon distal to the middle colic artery. All branches of the inferior mesenteric artery were ligated near their sources. The rectum and the rectosigmoid were mobilized down to level of coccyx. The abdomen was then closed. The perineal phase was then performed with the patient in the lithotomy position. The sphincter musculature was preserved and the rectum and colon were pulled through the anal opening until the distal portion of the transverse colon was drawn through. A Daniel's clamp with the rectal catheter in place was fastened to this bowel and the excess bowel removed.

The pathologic report was as follows: Gross description: The specimen consists of a segment of bowel 68 cm. in length. Various sized papillomatous masses arise from the mucosal surface. These are more numerous and larger in approximately the middle third of the specimen. In particular there is one large, pedunculated growth which has a stalk 4 cm. in length. The remaining polyps vary from 0.5 to 3 cm. in diameter. In the remaining portions of the mucosal surface an occasional polyp is seen.

Microscopic Description. A section of the large pedunculated mass shows a papillary neoplastic lesion of glandular mucosa. The cells are hypertrophied and the glandular pattern is exaggerated. However, no invasion of the stalk is noted. Sections from other regions show quite similar changes.

Diagnosis. Multiple papillomatosis with malignant adenoma. On 10-14-46, the redundant bowel was removed and the colon mucosa was sutured to the anal skin under lumbar analgesia.

The postoperative course was uneventful. The patient was permitted out of bed on the sixth postoperative day. He remained in the hospital a few days longer than necessary in order to drive home on 10-19-46, his sixteenth postoperative day. The patient was seen one month later. He had gained some weight; the sphincter contraction was excellent. The patient was re-examined in April, 1947. He complained of progressive weakness in both legs of some few weeks' duration and ataxic gait. Immediate consultation was sought with the anesthesiologist who had administered the fractional spinal and with a neurologist. The latter, Dr. S. F. Gilpin, Professor of Neurology at Temple University, made a diagnosis of myelopathy, following spinal anesthesia. A subsequent communication reports that the ataxia is unimproved, August, 1945.

Should the entire colon be involved, the growths in the rectum, if benign, may be destroyed and be followed by ileosigmoidostomy or ileorectosigmoidostomy and finally colectomy. Many authors subscribe to this plan of attack.[145, 180, 185, 209, 214, 220] Because of the tendency of malignant degeneration, removal of the entire rectum appears to be a more logical approach. Here the three-stage maneuver suggested by Rankin,[219] namely, permanent ileostomy, colectomy to the rectosigmoid and abdominoperineal excision, is recommended. The disadvantage in this method, of course, is the permanent ileostomy.

It has been our experience that, since recurrence of the adenomatous poly s even

after repeated fulguration, is so often encountered, the rectum should be removed as an integral part of the operation. Unlike colectomy for chronic ulcerative colitis, where we initially institute an ileostomy, here we establish a temporary transversostomy and remove all distal portions of the colon together with the rectum as the first stage. Where roentgenologic study by the double-contrast technic and particularly endoscopy of the remaining proximal segment reveal the presence of adenomatous polypi, a right hemicolectomy is performed approximately three weeks later. Such an example is evidenced in the following case:

W. B. (T.U.H. No. 127203), a white male, aged 23, was referred by Dr. W. Burkett with the diagnosis of multiple polyposis, July, 1947. Bleeding by rectum, pain in the abdomen, the passage of numerous stools and loss of six pounds in weight were cited over a six-month period. Examination disclosed a poorly nourished young man weighing 93 pounds. Two distinct sessile growths of large size were noted in the rectum associated with numerous adenomatous polypi of varying shape and size. Barium enema including an air double-contrast study demonstrated the presence of innumerable polyps distributed throughout the large bowel. Following two weeks of meticulous preparation, a left hemicolectomy and abdominoperineal excision was performed with a temporary transversotomy. His convalescent period was satisfactory, he was permitted out of bed on the fifth and discharged on the fourteenth postoperative day (Fig. 411). The removed specimen of bowel measured 105 cm. and showed disseminated polyposis.

Fig. 411. W. B., male, 23, with intestinal polyposis. (A, *Left*) Roentgenographic study showing disseminated adenomatous polypi throughout entire colon. (B, *Right*) Illustration showing distal ileum, cecum, ascending colon and proximal transverse colon. Adenomatous polypi may be seen throughout, two of which were shown to be adenocarcinoma, Grade II. This portion of the bowel was removed as a second-stage procedure.



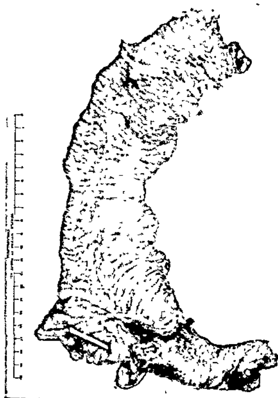




FIG. 411. W. B., age 23. Specimens (C) and (D) removed at first stage as a left hemicolectomy and abdominoperineal excision. (C, *Top*) This represents distal transverse splenic flexure and descending colon. Illustration (D, *Bottom*) removed at same time represents sigmoid and rectum. Two growths in rectum were adenocarcinoma, Grade II. Patient out of bed on the fifth day and discharged on the fourteenth day after operation. Patient returned in one month for hemicolectomy, as shown in page 567 (B).



Both growths in the rectum were adenocarcinoma, Grade II. While the wall was infiltrated, adjacent glands disclosed no evidence of neoplasia.

One month later following endoscopy and double-contrast study, the patient was readmitted and a right hemicolectomy performed with the establishment of a permanent

ileostomy. Again he was permitted out of bed on his fifth postoperative day, and, aside from irritation of the skin around the stoma, his condition was satisfactory. The removed specimen showed several polypoid processes of small size, two of which were reported adenocarcinoma, Grade II. Alive, well and working, December, 1948.

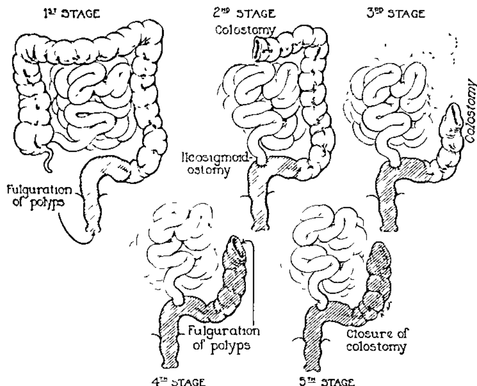


FIG. 412. Five-stage procedure of Mayo and Wakefield. (J.A.M.A. 107:342.)

In order to conserve the distal segment of the colon and entire rectum, Mayo and Wakefield[177] suggest a five-stage procedure in which, at the first stage, the polyps in the rectum and sigmoid are removed with repeated applications of surgical diathermy. (Fig. 412.) The second stage consists of an end-to-end ileosigmoidostomy and hemicolectomy with removal of the right half of the colon and as much of the right transverse colon as is deemed advisable. At the third stage, the remainder of the transverse colon and the descending colon are removed and a colonic stoma is formed. In the fourth stage, fulguration through that stoma is performed, and in the fifth stage, re-establishment of continuity of the bowel is obtained.

SUMMARY. Our experience with this disease entity, while not large, has been sufficient to formulate conclusions as to its surgical management. It is the author's opinion that with the establishment of the diagnosis of polyposis by sigmoidoscopy and roentgenography employing the double-contrast technic, radical surgical extirpation should be instituted without delay.

Of our sixteen patients, two refused operation, and an ileostomy was established in one who did not return for colectomy. In the thirteen remaining patients resection, total or partial, has been performed without fatality and with low morbidity. In all instances the rectum has been removed. In four cases proctosigmoidectomy and left hemicolectomy has been instituted with preservation of the anal sphincter musculature.

Endometrioma. Even though the term *endometrioma*[25] is a misnomer, inasmuch as it implies that the growth is a true blastoma, for which there is little supportive evidence,

it is employed here to represent a tumor containing aberrant endometrium or tissue resembling endometrium which responds to the same stimulus as that affecting normally placed endometrium. It tends to enlarge slowly, is capable of invasion and metastasis, but is curable. A combination of these endometriomas, although better designated *endometrial tumors*,[191] constitutes a progressive disease commonly referred to as "endometriosis."[231] The term *adenomyoma* or "chocolate cyst" was formerly used to describe these tumors, and to some extent is still employed interchangeably. *Adenomyosis*[89] and *peritonitis adenoides*[272] have been applied also.

Goodall[93] of Montreal, in an excellent monograph, has described a less common variety of endometriosis in which the glandular structure of the endometrium is not present in the implants but the stroma of the endometrium occurs as the invading tissue.

Incidence. Formerly considered a rare condition, endometriosis is now relatively common and occurs with sufficient frequency to be included among the important benign lesions of the rectum and sigmoid colon. Sampson, as reported in a recent article, found endometriosis 101 times in 474 gynecologic operations, and Green-Armytage[90] recorded an incidence of 8.9 per cent in a series of 1,000 consecutive surgical cases.

Age, Race, Sex. Endometriosis is almost exclusively a disease of women in the child-bearing age. The vast majority are seen between the thirtieth year and the menopause, although cases have been reported as early as 11[212] and as late as 72.[89, 272] In women over sixty years of age, Pemberton[201] feels that a granulosa cell tumor of the ovary must be considered. So far as race is concerned, most cases have been in white women. Various structures may be involved by this process, the more important of which are the ovaries, uterus, tubes, uterine ligaments, portions of the intestine such as the small bowel, appendix, cecum, sigmoid and rectum, the peritoneum, omentum, bladder, and pouch of Douglas or rectovaginal septum, vagina, vulva, cervix, femoral and inguinal canal, umbilicus and abdominal wall.

Etiology. Probably the most plausible theory is that promulgated by Sampson[232] and known as "transtubal implantation." This investigator contends that particles of endometrial tissue or tubal mucosa are detached and regurgitated with the menstrual blood to become implanted upon a site that is especially susceptible, such as the ovary or pelvic peritoneum. These implanted particles tend to produce endometrial or chocolate cysts in the ovary. The ovarian endometriomas enlarge at the time of menstruation, fill with blood and rupture so that their contents gravitate and implant themselves on adjacent structures, usually the posterior wall of the uterus and the anterior wall of the sigmoid. Here they undergo secondary growth. Some investigators, however, argue against this hypothesis in that it does not explain the presence of extraperitoneal implants such as in the rectovaginal septum, at the umbilicus and in the inguinal region. The serosal theory[121] is based on the fact that the entire epithelium of the female genital tract is derived from the celomic mesothelium, so that as a result of chronic irritation or the like, the serosa may undergo metaplasia or revert to its primitive function. One theory is that endometriosis is the result of cellular metaplasia brought about by glandular dysfunction.[6] That these tumors develop in adult life from embryonic rests, from Müllerian ducts or the Wölffian body has been suggested also.[112, 222] Still another belief is that these tumors are diverticula of endometrium which invade the wall of the uterus and adherent structures. Many other hypotheses have been offered, but as they are of no significant import, it would be unwise to consider them here.

Classification. Heidler[103] divides this disease into endometriosis interna, representing the presence of heterotopic uterine

glands in the deeper muscular layers of the uterine and tubal wall, and endometriosis externa. It is in this latter group that we are especially interested, since involvement of the rectovaginal septum, rectum and sigmoid is the most frequent and important of all the external endometrioses.

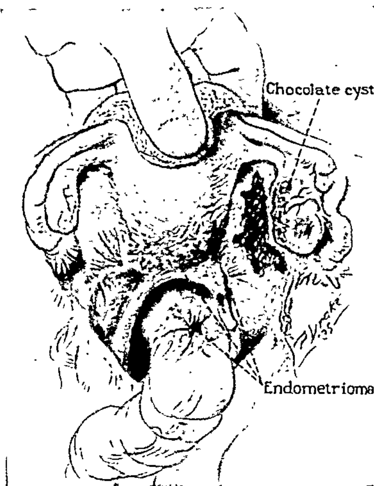


Fig. 413. Multiple endometrial transplants with endometrioma or adenomyoma in the sigmoidal wall. Small chocolate cysts in the right ovary. (Masson: Ann. Surg. 102:824.)

Pathology. There are two types of extension of endometriosis in the pelvis. The well known "chocolate cyst" tumefaction with accompanying formation of adhesions and penetration of adjacent structures is the usual type of endometriosis which results in dense adhesions either localized or extending throughout the pelvis.[102] The most common site of endometrial implants is where the peritoneum is folded irregularly, namely, the antimesenteric border of the sigmoid, at the attachments of the epiploic appendices and in the cul-de-sac of Douglas. In the majority of cases these implants present themselves as one or more firm nodules varying in size from a buckshot to a cherry, and situated in the rectovaginal septum or cul-de-sac of Douglas. Ordinarily they are slightly movable and tender. This type of endometriosis is a development from the "spill" of endometrial tissue from the fimbriated end of the fallopian tube.

The second type of extension of endometriosis refers to the rectum and perirectum. Goodall[93] describes direct lymphatic extension from the parametrium of the uterine wall with an infiltrative type of growth developing in the rectum or perirectum. In Goodall's experience there have been many such cases. It is important to distinguish between endometriosis and malignancy in such instances. The fact that the rectal mucosa is seldom invaded by the nonmalignant condition is of great value. This explains why ulceration rarely occurs and bleeding is seldom mentioned.

Involvement of the sigmoid, according to Cullen,[64] is secondary to endometriosis of the rectovaginal septum. On the sigmoid the endometrial or adenomyxomatous tumors are of small size and occur as tarry cysts or raspberry elevations. A marked degree of puckering and scarring is noted which simulates that produced by a scirrhous carcinoma. Where stricture exists it will be found hard and annular in type, yet usually the mucosa is uninvolved. The adhesions in patients with endometrial implants are almost pathognomonic in that they are quite firm and rigid.[61]

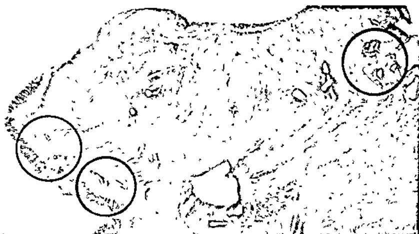


FIG. 414. Endometriosis of the sigmoid. Low power × 10 showing general topography of the much thickened intestine with the normal mucosa along the lower border. Several groups of epithelial-lined spaces may be seen lying in the submucosa and also deep in the thickened wall, particularly in the upper portion of the section. (Schofield and Bacon: Ann. Surg. 107:1025.)

The disease process may become diffuse inside the muscular coat of the rectum or sigmoid, and after almost completely encircling it, may cause subsequent narrowing of the lumen. There are multiple reports of intestinal obstruction due to this endometrial tissue invasion. Goodall[93] mentions two cases in which the obstruction was due to large chocolate cysts pressing upon the bowel lumen. One cyst was in the mesoileum and the other in the mesorectum. In the latter instance the cyst was aspirated, and the obstruction was thus relieved. Removal of all ovarian tissue was the other factor in the cure. Other writers mention the infiltrative type of growth.[200] Wood, Deibert and Kain[201] report complete ileal obstruction. Cattell[47] cites two cases of endometriosis of the sigmoid with almost complete obstruction. Jenkinson and Brown[124] state that 21 of 47 patients with endometriosis of the rectosigmoid had obstructive symptoms to some degree. Eighteen of 38 patients reported by Mayo and Miller[174] showed narrowing of the bowel lumen on proctoscopy. Varying degrees of intestinal obstruction are thus found, depending upon the duration and severity of the endome-

triosis. Malignancy has developed from an endometriosis situated in the rectovaginal septum.[212, 270] In one case metastasis to the lung was noted.[159]

HISTOPATHOLOGY. Section shows the presence of gland ducts extending beneath the mucosa into the muscular layer. The glands are lined with a single layer of typical endometrial epithelium, while outside the gland is a thin zone of endometrial stroma. Varying amounts of fibrous tissue are noted between the smooth muscle fibers. Ordinarily the mucosa is unchanged, although scattered areas of atrophy are noted. (Figs. 414, 415, 416.)



FIG. 415. Area A. Endometriosis of the sigmoid. High power (× 100). A. showing normal mucosa and submucosa in which a portion of the endometrioma is seen below. Note the large glands lined with tall columnar epithelium surrounded by typical tunica propria similar to that in the uterus. (Schofield and Bacon: Ann. Surg., 107: 1026.)

As will be seen, the rectovaginal septum is the most common site of extra-abdominal endometriosis. In a series of 576 patients with adenomyoma affecting 689 organs, Masson[168] found the rectovaginal septum involved in 20 cases and the sigmoid in 14. Polster[212] collected 90 cases and Keene[131] six in a series of 118. Other instances of endometrial involvement of the rectovaginal septum, rectum and sigmoid have been reported.[24, 49, 59, 62, 63, 79, 91, 98, 120, 125, 137, 154, 160, 162, 182, 184, 191, 199, 200, 202, 225, 226, 237, 238, 251, 297, 299, 300, 301]

SYMPTOMS. In a general way it may be said that the symptoms of endometriosis are similar to those of chronic inflammation without the infection and suppuration. Although they vary according to the size and extent of the growth, in almost every case the symptoms are increased in intensity at the time of menstruation. Usually, a history of progressive constipation over a period of months or years is cited by the patient, yet in a few instances the constipation becomes so obstinate in type that when the patient seeks advice a partial obstruction is found. Pain in the rectum is more or less a constant feature and is described as a dull, aching discomfort, increased by defecation and especially severe during the menstrual period.

Attention has been called to the fact that the symptoms tend to become worse and more prolonged each month where no treatment is instituted.[241] Dyspareunia, dysuria and pain over the sacral region are not uncommon, but bleeding is infrequent. Diarrhea may occur, but is unusual. Sterility has been cited in from 30 to 40 per cent of all cases observed. Dull abdominal pain in the left lower quadrant is usually present

where the sigmoid colon is involved.

DIAGNOSIS. A history of rectal pain in a female during the age of ovarian activity that is accentuated constantly and progressively at each menstrual period and does not entail rectal bleeding is highly suggestive of endometrial invasion of the rectum or rectovaginal septum. In the presence of the same symptoms, together with progressive constipation and left lower abdominal pain, involvement of the sigmoid must be suspected. Digital examination elicits one or more firm nodules in the septum that are usually exquisitely tender, not fixed, with the overlying mucosa movable and intact. Stricture of the sigmoid due to endometrial implantation is not usually complete in its circumference. It is of annular type and hard, with much puckering, but the mucosa is almost normal.

Opinion varies as to the reliability of roentgen findings in endometriosis. Jenkinson and Brown[124] state that endometriosis of the rectum and sigmoid is characterized roentgenographically by a long, filling defect with sharp, regular borders, intact mucosa, inconstancy of the filling defect and fixation of the bowel, which is exquisitely tender to palpation. Cattell,[47] as well as Mayo and Miller,[174] finds no distinguishing features.

At operation, sigmoidal endometriosis is diagnosed by the presence of chocolate cysts adherent to the surface which, when removed, reveal areas of puckering. The infiltrative endometrial lesion may contain no cyst formation. A positive diagnosis is made by histologic examination.

DIFFERENTIAL DIAGNOSIS. Endometriosis of the rectum and sigmoid is to be distinguished from malignancy and diverticulitis. The distinctive characteristics of each are here tabulated.

TREATMENT. For the treatment of endometriosis of the rectovaginal septum, rectum and sigmoid colon, surgery, radium or roentgen rays may be employed. The underlying principle, of course, is that retrogres-

TABLE 45. DIFFERENTIAL DIAGNOSIS OF ENDOMETRIOSIS

	ENDOMETRIOSIS OF THE RECTUM AND SIGMOID	MALIGNANCY	DIVERTICULITIS
Age	25-45	40-60	50-60
Sex	Female only	Usually male	Usually male
Characteristics	Occurs as small nodules slightly movable; overlying mucosa uninvolved. Physiologic response during menstruation No enlarged glands in drainage areas	Irregular, nodular mass; firm, broad base; indurated and fixed; edges of ulcer raised and rolled. Tends to recur	Hernial protrusions of sacs; nubbin-shaped, sometimes elongated. Fever associated. Leukocytosis
Size	Buckshot to cherry	Much larger	From a few mm. to an inch or two
Number	One or more	Single	Numerous
Location	Rectovaginal septum most common	Upper rectum, posterior wall most frequent	Usually sigmoid between longitudinal bands and mesentery
Ulceration	Rarely	Always in advanced cases	Infrequent
Effect of *menstruation*	Worse	Not affected	Not affected
Malignant	No	Yes	No
Metastasis	Yes	Yes	No
Prominent symptoms	Periodicity of pain; tenderness	Bleeding usual; change in bowel habit; pain late	Attacks and remissions; pain and constipation
Loss of weight	Moderate	Marked	Less marked
Roentgenogram	Usually negative	Filling defect in sigmoid or upper rectum, depending on site of growth	May show diverticula of sigmoid, especially after double-contrast enema

sion is dependent upon inhibition of ovarian hormonal stimulation. Lockyer[179] reports good results after total hysterectomy and bilateral oophorectomy with entire regression of the rectal tumor. The entity certainly deserves precise individualization because of such factors as age, the desire of the patient to conceive, the degree of symptomatology produced, the associated pathology present in the pelvic organs, the exact status of the lesion involving the bowel, particularly obstruction, whether imminent or actual, and whether malignancy is suspected. While it is recognized that the safest and simplest procedure is to remove all ovarian tissue following which the growth will regress and the symptoms disappear except where the rectal or sigmoidal growth is very large or a stricture is present, conservatism is to be recommended. If, after careful examination of the bowel, malignancy cannot be excluded, resection is deemed justified. Patients in the older age group in which future childbearing is not a factor may be given roentgen or radium therapy, thereby inducing an artificial menopause. Instances have been recorded where the endometrioma of the bowel has disappeared under the influence of roentgen or radium therapy, or a combination of the two.[5, 106, 181, 236, 239] Intestinal obstruction due to endometriosis demands surgical intervention. Where the patient is a young woman and desires preservation of the ability to conceive and the pelvic organs are essentially normal, resection of the involved segment of bowel is recommended. In the presence of extensive endometriosis of the pelvic organs and sigmoid or rectosigmoid, panhysterectomy and bilateral oophorectomy is ordinarily the procedure of choice. The establishment of a temporary colostomy orad to the involved portion of bowel is indicated in the presence of complete obstruction or even incomplete, should marked dilatation of the proximal segment of bowel exist.



Fig. 416. Area B. High power (× 150) showing the endometrioma deep in the thickened intestinal wall. Note the typical tunica propria around the columnar lined glands. (Schofield and Bacon: Ann. Surg. 107: 1026.)

CARCINOID (ARGENTAFFIN TUMOR)

This variety of tumor may be included under the heading of either malignant or benign tumors. In fact, Ritchie and Stafford[224] have proposed two classifications, benign argentaffin tumor and argentaffin carcinoma. It is true that carcinoid is capable of metastasis and may present characteristics of true cancer. Carcinoid was

first described by Kultschitzky in 1897, who considered them to be tumors composed of epithelial cells. A few years later, Schmidt described them as chromaffin cells, while Gossett and Masson[95, 109] demonstrated cytoplasmic granules. These investigators observed that silver compounds were reduced by these granules, leaving as a residue brownish-black particles. These were designated "argentaffin cells."

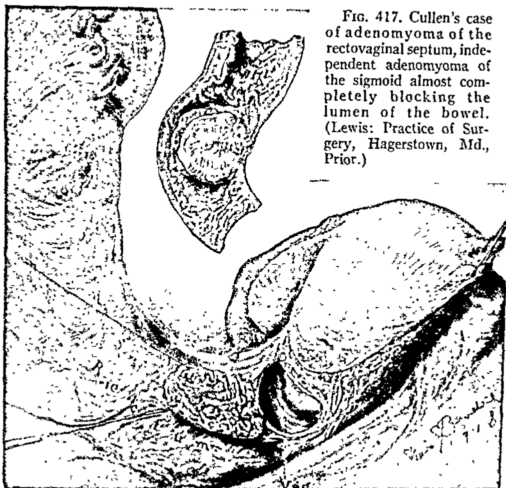


Fig. 417. Cullen's case of adenomyoma of the rectovaginal septum, independent adenomyoma of the sigmoid almost completely blocking the lumen of the bowel. (Lewis: Practice of Surgery, Hagerstown, Md., Prior.)

Argentaffin tumors or carcinoids are relatively uncommon. Humphrey[117] found 8 cases in 3,200 autopsies; Porter and Whelan[213] 10 cases in 2,922 autopsies, and Raiford 29 in 62,000 operative and autopsy specimens. Although the appendix and ileum are the usual sites,[181] the rectum has been involved in a few instances.[40, 76, 107, 122, 164, 210, 213, 223, 243, 217, 204]

Etiology. The origin of carcinoids is still controversial. Some investigators believe they arise from the mesenchyme, while others feel that they are epithelial cells derived from the endoderm. Raiford[216] is of the opinion that these growths arise from the argentaffin cells, while Horsley and Keasbey[115] consider an interrelationship to neuroblastomas.

Pathology. The carcinoid is a highly characteristic, nonencapsulated yet circumscribed tumor occurring in the submucosa of the intestine. It is freely movable below the mucous membrane and is firm and elastic on palpation. Infrequently, carcinoids may assume a polypoid shape. While more frequently single, they may be multiple. Multiplicity of growth has been described by Rigdon.[223] On section a bright yellow color is presented. While ulceration rarely occurs, metastasis is not uncommon. To regional nodes, the incidence of metastasis has been computed at 10 per cent

and to distant sites, such as the liver, 1 per cent. In Humphrey's series, metastasis occurred in 24.4 per cent and in Dangremond's group, 52 per cent. Intestinal obstruction was reported in 24 per cent of the cases. Carcinoids are potentially malignant, although their grade of malignancy is usually low. Histologically, the morphology both in the benign and malignant type is found to be quite uniform. The cells grow in nests and columns of variable size in the submucosa. While the nuclei are small, spherical and hyperchromatic, the cytoplasmic membranes are usually obscure. Occasionally the cells may be arranged in rosettes resembling those of neuroblastoma.[19] It would seem that the festooning ribbons of columnar cells represents the reproduction on a large scale, of the basigranular cells in an earlier stage of differentiation, when they approximate the shape of columnar crypt cells. According to Stout, the failure of the tumor cell granules to blacken ammoniacal silver nitrate, and in the same preparations in which the granules in the basigranular cells in the crypts were blackened, is explained if it is supposed that the latter contained "enteramin," while the tumor cell granules lacked it. If this be accepted, then these tumors may be regarded as carcinoids composed of Erspamer's preenterochrome cells. Carcinoid of the rectum seldom causes symptoms. Treatment consists of excision alone or in combination with radium. The results reported following complete removal are excellent.[8, 19, 88]



Fig. 418. Carcinoid of rectum showing submucosal "nests" of small dark benign tumor cells embedded in dense connective tissue. (× 92.) (Dr. Mildred Pfeiffer.)

PARAGANGLIOMA

Counted among the rarer types of tumor growth are those whose point of origin is located in chromaffin tissues of the body. Special mention is made of that form known as pheochromocytoma or paraganglioma. These tumors are supposedly closely integrated with the autonomic nervous system.

Various classifications of nomenclature have been given, such as the two mentioned above and also chromaffinoma. The first term usually denotes the renal medulla as the site of origin. The second is used for

those arising in any one of the extra-adrenal sites of origin.

Where the sacrococcygeal region is specifically mentioned as the origin of growth, the tumor is classified as a paraganglioneuroma. The most common site referred to is the bifurcation of the aorta, apparently coincident with what is known as the organ of Zuckerkandl.

There seem to be variant opinions as to whether or not the glomus contains chromaffin tissue. Anatomically, it consists of a group of convoluted vessels having an afferent artery and efferent vein. The body is reported by Stoerk[254] to contain no chromaffin tissue in which these tumors supposedly originate, and, in addition, it is also reported to be unrelated to the sympathetic nervous system, although the structure as found in the adult is surrounded by a well defined zone of nerves called the "nerve cuff," which is comparable to that found in the cutaneous glomus.[123, 167] Stone[255] believed it to be just one of a number of paraganglia which may give origin to paraganglionic tumors.

The function of the glomus is still unknown, but it seems well established that it possesses no function as a gland of internal secretion. Tumors have been reported as originating in the glomus and have been classified as epitheliomata or angiosarcoma;[139, 143] but in the light of present-day knowledge these are, in all probability, angioneuromas, since they are similar to those arising in the cutaneous glomus.

Brunschwig and Humphrey,[41] in a discussion and report of a case, stated that benign tumors arising from the medulla of the adrenal gland or similar structures but occurring extraglandularly in the retroperitoneal space are being reported with increasing frequency.

Belt and Powell,[26] in 1934, reviewed 36 reported cases, and by 1939 Humphreys collected 103 cases from the literature. Rather pertinently, most of these reports

Schematic Histology and Biology
Sympathogonion

Neuroblast	Pheochromoblast
Tumors Neuroblastoma Sympathicoblastoma Both malignant	Tumors Pheochromoblastoma Malignant and very rare
No Endocrine Symptoms	Endocrine Symptoms
Sympathetic ganglion cell (Very few in adrenal medulla)	Adrenalin production
Tumors Ganglioneuroma Very rare Benign and occasionally malignant	Chromaffin cell (pheochromocyte) forming bulk of medulla
	Tumors Pheochromocytomas Benign Extra-adrenalin chromaffin tissue may have above types of tumor

These are termed Paraganglioneuromas { Organ of Zuckerkandl; carotid body; tissue in sacrococcygeal region

From Linder, C. U., and Tyler, H. Y.

NEURAL CREST DERIVATIVES

SCHEMATIC

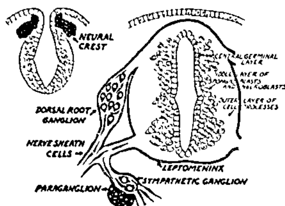






FIG. 419. Retrorectal paraganglioma. Photomicrographs 1 × 100 and 1 × 200 show islands of epithelial cells in a connective-tissue matrix. (Young and Hicks.)

dealt with postmortem observations.

Young and Hicks[208] reported a case of retrorectal paraganglioma in January, 1946, the illustrations from which are herewith shown (Fig. 419). The latter author states:

> Paraganglioma is a generic term applied to tumors of the paraganglions of the sympathetic and peripheral nervous system. Paraganglions are, like the sympathetic nervous system, derived from the embryonic neural crest. The best known paraganglions are the adrenal medulla and the carotid body, but similar chromaffinic tissue is found in association with other parts of the peripheral nervous system and in the form of enterochromaffin cells in the intestinal and bronchial epithelium. The best known paraganglioma is the carcinoid, while much less frequently encountered ones are the carotid body tumor and the pheochromocytoma of the adrenal medulla. Paragangliomas may apparently arise anywhere in the peripheral nervous system, but aside from the carcinoid of the gut they are rare. In general, these tumors tend to remain benign, but malignant forms occur with metastases.

Because of the location of the tumor reported by the authors, the possibility certainly must be considered that it originated from the anococcygeal body, which is said to be a paraganglioma.

Histology

The tumor is composed of polyhedral cells of various shapes and sizes arranged in alveolar masses, gives the characteristic chromaffin reaction when fixed with chrome salts and contains in addition, an excess of adrenalin.

Treatment

Excision of the tumor is essential. In the doubtful cases exploration should be done, for the benefit accruing from a successful extirpation far outweighs the possible dangers of operating on a case of this type. Under no circumstances should chloroform, cyclopropane or spinal anesthesia be used.

BOWEN'S DISEASE

In 1912, Bowen[36, 37] of Boston described certain chronic lesions of the skin in three cases of long duration. Since that time a moderate number of cases has been reported from many parts of the world. Nicolas *et al.*,[195] in 1930, collected 64 cases from the literature. Bowen's disease concerns primarily the superficial layers of the skin, but not infrequently the oropharynx, genital or anal regions are involved. Several cases of the anal and perianal aspects have been reported.[9, 55, 90, 147, 161, 217, 221, 285]

Causes. Stout[258] lists the causes as spontaneous, secondary to postradiation dermatitis, the result of experimental skin-tarring in animals, arsenic or a development of senile keratosis.

Incidence. Cases are approximately equally divided between males and females, are predominantly persons of the white race and are found frequently in persons from 50 to 70 years of age. The youngest patient reported was 25 years of age.

Histopathology. Bowen's original description clarifies the microscopic findings. Histologically the lesions showed a marked proliferation of the rete malpighii in every lesion excised. There were very numerous evidences of karyokinetic division and amitoses, with peculiar clumping of the nuclei and vacuolization of the cells. In the more advanced lesions there was an hypertrophy of the horny layer, a hyperkeratosis and parakeratosis with abundant evidence of the cells not having undergone the process of cornification, but showing nuclei surrounded by membranes or clear spaces. An edema of all the epidermal layers was apparent in the more advanced lesions and was sometimes so pronounced that a crust was formed at the surface.

Symptoms. Typical case histories revealed painless, usually small lesions of several years' duration in the skin or mucous membranes. The small, brownish papules gradually became crusted, slowly thickened and ulcerated, in some instances, with a thin discharge. A thickening of the epithelium was present, and there was, at times, definite tumor formation which felt firm to the touch.

Diagnosis. A patient with the symptom complex described in the preceding paragraph may be suspected of having Bowen's disease. According to Herold and Cooper,[110] the clinical picture must be supplemented by the microscopic findings of Bowen's cells with clumped nuclei, dyskeratosis and an intact basal cell layer.

Differential Diagnosis. Bowen's disease closely simulates various skin lesions and needs to be differentiated from epithelioma, syphilis, arsenical keratosis, senile keratosis, seborrheic keratosis, lupus vulgaris and psoriasis.

Malignant Aspects. Bowen's first two cases were benign; his third developed into a malignant epithelioma. Whereas the originally described lesion was localized to the epidermis, cases found later in other case reports had broken through the basement cell membrane and had become invasive. Stout states:

> "In 2 or 3 per cent of skin cases, and in about 40 per cent of mucosal cases clinical cancer results, of two morphological types, (i) an atypical or metatypical squamous cell epithelioma, or (ii) a true Bowen epithelioma with reproduction of the bizarre characteristics of the Bowen cells without any other epidermoid features. An important feature

of the Bowen epithelioma is occurrence of metastasis with a minimal amount of local penetration which may defy clinical detection and even escape ordinary microscopic study, so that only serial sectioning of the entire lesion will reveal it."

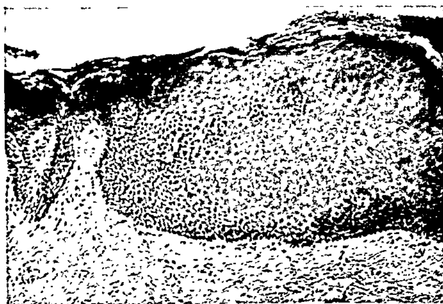


FIG. 420. Moderate surface keratinization with mild hyperplasia of stratified squamous epithelium. Retia show some elongation and thickening. (H. E. Bacon and F. D. Wolfe: Tr. Am. Proct. Soc. 42:161.)

Kuznitsky[114] has reported a case of malignant Bowen tumor with metastasis to distant lymph nodes and eventual fatality. Vickers *et al.*[281] discuss Bowen's disease as a variety of epidermoid carcinoma in situ.

Treatment. All manifestations of Bowen's disease are potentially malignant. Therefore, radical treatment of the lesions is indicated. Various methods have been employed, such as surgical excision, roentgen therapy and electrodesiccation. Excision by sharp knife or endotherm knife seems to offer the best results.

KRAUROSIS ANI (LEUKOPLAKIA)

The term *kraurosis*, derived from the Greek word meaning "dry," should be employed, according to Darier,[13, 67] to designate a progressive sclerosing atrophy of the mucocutaneous tegument leading gradually to stenosis. As extensions from the vulva to the integument of the perineum and anal canal, innumerable instances have been cited under the terms leukoplakia,[69] scleroderma, neurodermatitis, psoriasis and pruritus. A review of the literature on anal involvement reveals kraurosis to be exceedingly rare. The solitary case we were able to discover in the literature, was reported by Fitch[83] as occurring in a Chinese male, 55 years of age. His complaint was of itching and burning. Inspection disclosed a circular area about the anus of dull white color. Much confusion attends the interpretation of the conditions of kraurosis and leukoplakia, although Hunt[113] believes them to be distinguishable both clinically and pathologically. Usher and Campbell[276] concur in this view. Hailey,[100] however, is of the opinion that kraurosis represents an advanced process and is nothing more than a dry, chronic eczema in the atrophic stage.

The process first manifests signs of inflammation followed by those of atrophy. The tissue becomes thickened, inelastic and

of whitish or grayish color. Later, atrophic changes occur. The epithelium becomes smooth, glistening, parchmentlike and semi-translucent.

Histologically the changes are those of atrophy. There is relative and often absolute hyperkeratosis with change in the stratum granulosum. The atrophy of the prickle-cell layer is marked, and liquefaction necrosis of the basal layer is apparent. Edema beneath the epidermis, homogenization of the connective tissue, especially in the upper portion of the cutis, obliteration of the rete ridges and perivascular infiltration composed of lymphocytes and later fixed connective cells are in evidence. In later stages, varying degrees of parakeratosis are present and sclerosis of the deeper vessels. The chief concern of kraurosis is that of malignancy. In the single case revealed by perusal of the literature and in five cases cited by Turrel,[275] all of which involved the anal canal alone, no degeneration of a malignant nature was noted. Cattell[18] considers the lesion to be definitely precancerous, while Adair[1] believes that malignancy, always of the squamous-cell type, occurs in a higher percentage of cases than in any other premalignant process.



Fig. 421. Hyperplasia in evidence in cells of stratum granulosum and in the prickle cell layer. Atrophic appearance with thinning of the epidermis and almost complete effacement of the rete pegs. The corium is densely fibrotic. (H. E. Bacon and F. D. Wolfe: Tr. Am. Proct. Soc. 42:161.)

Berkeley and Bonner,[30] on the other hand, do not feel that it serves as a precursor to cancer. Itching of varying intensity is usually the chief symptom. Five cases have come under our care with the lesions confined to the anal canal. One of these was reported by Wolfe and the writer elsewhere.[18]

Author's Series

Name	Sex	Age
I. K.	F	40
S. K	F	27
A. C	F	45
R G	M	31
F. W.	M	9

Mrs. I. K., aged forty years, was seen in consultation in January, 1940, because of difficulty with bowel movement since the performance of a hemorrhoidectomy five and

one-half years previously. Frequent desire for stool, incompleteness of evacuation and the passage of watery stools intermittently were cited. There was no pain, bleeding, itching or loss of weight. Her periods were regular. She

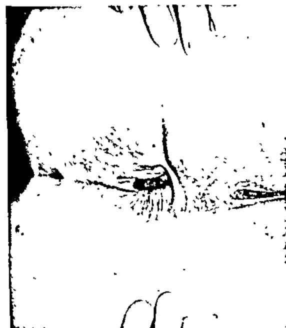


FIG. 422. Kraurosis ani.

had two children living and well. Past and family histories were negative

On examination, extensive external varicose hemorrhoids, a marked anal stenosis and mucous prolapse were noted. The integument of the anal canal from the margin to the anorectal line was of a dull white color, smooth and inelastic but ragged at its upper extent. In addition to the above-mentioned pathology, a diagnosis of postoperative fibrous tissue proliferation simulating kraurosis was made and operation advised

On April 10, 1940, under lumbar analgesia, the entire anal canal was denuded of its lining skin. The integument overlying the external hemorrhoidal tissue was preserved and the hemorrhoids dissected free and discarded The edges of the loose anal margin were then drawn to the divided anorectal line and tacked in place using a single tier of No. 00 chromic catgut interruptedly arranged about the entire circumference.

The histologic report was as follows:

"The specimen in some areas shows moderate increased surface keratinization with mild hyperplasia of the stratified squamous epithelium, the hyperplasia being evident in the cells of the stratum granulosum and in the prickle-cell layer. The retia shows some elongation and thickening. In other areas the skin surface has an atrophic appearance with thinning of the epidermis and almost complete effacement of the rete pegs. The corium is densely fibrotic, and in its midportion can be seen several dilated vascular channels choked with blood. The histologic picture is that of kraurosis ani. If this were a leukoplakic lesion we would expect to see more marked keratinization and a markedly hyperplastic epidermis without areas of atrophy. The retia likewise would show marked distortion. There is no evidence of malignancy in the sections studied. Diagnosis: Kraurosis ani."

Another case is described as follows:

A.C.C.: A white female, age 45, offered the complaints of intractable pain in the rectum and anal canal and incontinence.

Past History. The patient first complained of symptoms in May, 1931. Several diagnoses were made and several operations performed. Subsequent dilatation, cauterization and excision of the fissure were made. Uterine suspension, in 1935, offered relief for one year. In 1936, another rectal operation gave temporary respite, but still another in 1938 was followed by accentuation of the pain. Two additional operations in 1939 were followed by sharp throbbing pain, exhaustion, diarrhea and incontinence. The Elliott treatment was administered, roentgen therapy to the coccygeal area and intrarectal diathermy. Several biopsies were taken. Only one was indicative of a malignant process; all others were inflammatory. In 1943, the posterior quadrant of the anal canal was excised, which was followed by a rather intractable infection. Additional roentgen therapy failed to offer relief. In 1944 and 1945, the scar tissue was destroyed by an "electric method." Four more operations were performed; two courses of penicillin were administered, a fatty tumor was excised, and roentgen therapy given. In 1946, another operation upon the rectum failed to relieve the condition, after which a colostomy and perineal excision was advised. She was referred to the writer in May, 1946, because she would not accept an abdominal colostomy. Our notes of the examination as of that time are as follows:

"The anal aperture shows marked distortion. Multiple scars are evident from the perineum to the sacrococcygeal skin and of the skin of both ischiorectal fossae. The anal skin is definitely demarcated from the rectal mucosa

and gives the appearance of kraurosis. Digital examination reveals impaired sphincter function. In June, 1946, a perineal proctosigmoidectomy was performed with preservation of the sphincter musculature. One scar was excised, and in this site the muscles were plicated and sutured. The patient made an uneventful recovery, but sometime thereafter, when she had returned to her native state, pain in the presacral area was experienced. Apparently this was relieved by 'injections,' the type of which the writer is not certain, and diathermy. Frequent communications by mail and two visits before May, 1947, have revealed that this patient returned to work as secretary three months following operation and has been free of pain. The incontinence has improved. The diagnosis of kraurosis was confirmed by serial section."

Note: In July, 1948, the author learned that an abdominoperineal excision was performed because of recurrent pain.

The condition has been more or less relegated to the female sex, especially during the menopausal and postmenopausal periods. Treatments directed thereto, such as estrogen administered parenterally, have not offered results that are too encouraging.[135] Swift[261] advises the use of hydrochloric acid, inasmuch as he believes that a common factor is present in pruritus, leukoplakia and kraurosis; and that it is achlorhydria which causes a deficiency of vitamin A in the diet. Besides the acid by mouth, he prescribes cod-liver oil orally and a local application of a cream composed of zinc oxide and starch with sweet almond oil. Sparrow[250] has recently reported six cases of leukoplakia that clinically resemble esthiomene.

LYMPHOGRANULOMA (HODGKINS' DISEASE)

True lymphogranuloma of the large bowel is of rare occurrence. A review of the literature reveals only six reported cases.[102, 103, 153, 201] The diagnosis is made usually by histologic section of the lymph nodes.

PSEUDO-ADENOMATOUS POLYPS

Pseudopolyposis, postinflammatory diffuse polyposis, colitis polyposa and *pseudopolyp* are terms employed to distinguish from true adenomatous polyps arising from a primary epithelial hyperplasia. It is recognized that an inflammatory variety does exist, such as is commonly seen associated with extensive destruction of the mucosa as a result of chronic ulcerative and amebic proctocolitis or any inflammatory reaction. Granulation tissue from denuded areas may produce ragged edges or fingerlike projections of the bowel mucosa. Unlike true adenomatous polyps, which do not tend to disappear, pseudopolypoid growths may regress, with healing of the ulcerative process (see p. 287).

ANGIOMA

Angioma of the anus, rectum and colon is extremely rare. Although the vast majority disappear at birth or shortly thereafter, the few cases reported in this location have been described as occurring between the ages of 10 and 48.[27] The female sex has the greater propensity in the proportion of 1.5 to 1.[170]

Angiomata, which are supposed to originate in the submucosa, are tumors composed of either blood vessels or lymphatics. The former are termed hemangioma and the latter lymphangioma. Either may be single or multiple.

Hemangioma

According to Kornmann,[141] this variety constitutes only 7 per cent of all benign tumors of the gastro-intestinal tract. An instance of double intussusception at the site of a cavernous hemangioma was described by Nicoll in 1899.[196] Buie and Nesselrod[45] cited a case of diffuse hemangioma of the rectum, while Bancroft[20] recorded one involving the sigmoid. Colostomy, ligation of the superior hemorrhoidal vein and injection of 10 cc. of 40 per cent sodium salicylate were successfully performed. Kaijser[127] collected and classified hemangiomas (see table on page 585).

Ordinarily two types of hemangiomas are described, the capillary (Fig. 423) and the

cavernous (Fig. 424). The capillary type is more common in the anus and perianal region, although involvement of the rectum and sigmoid has been observed. When present, it usually forms a distinct patch that is relatively soft and red or purplish-red in color. On section it is composed of a network of newly formed capillaries of small size and filled with blood. Under certain conditions the endothelial cells lining these capillaries become excessive and produce several layers of cells. This endothelial proliferation may be so marked that the lumen of the vessels becomes obliterated and, as a result, a compact mass of cells is formed to which the term hemangio-endothelioma is applied. Cases of hemangio-endothelioma of the anus have been reported by Smith and Broders,[247] as well as Tucker and Hellwig.[273] In the first of these the growth was present as a small, firm nodule that was quite painless and resembled a thrombotic external hemorrhoid. The cavernous type is less common. It may occur in the anus, rectum or sigmoid as a spongy, flat tumor or tumefaction, but quite often the involved bowel wall shows only bluish varicosities. The growth on section consists of dilated blood vessel spaces of variable size and shape, lined by endothelium with little fibrous connective tissue.



Fig. 423. Enormous nevus (angioma) involving the buttocks, the anus and the rectum. (Gant: The Rectum, Anus and Colon, Philadelphia, Saunders.)

The outstanding symptom of these tumors is bleeding, which often is noted in the early part of life and recurs for years if untreated. Diagnosis is made with the proctosigmoidoscope in many instances. The dilated bluish veins may have a normal mucosa overlying them or the mucosa may be beefy-red. More cases have been reported in the rectum and sigmoid than elsewhere in the colon.

Treatment. In cases of extensive hemangiomata radical measures may be indicated. Radiation has been deemed ineffective. Excision of the bowel containing a large hemangioma of the cavernous type seems to offer the best results, utilizing whatever method is most suitable. The

	Pinpoint Multiple Varicosities	Diffuse Infiltrating Cavernous Hemangioma	Circumscribed Cavernous Polypoid Hemangioma	Hemangioma Simplex (Telangiectasis)	Hemangiomatosis
Sigmoid		7	1		
Rectum	3	12	3		
Large Bowel	9				2

Kaijser, R.

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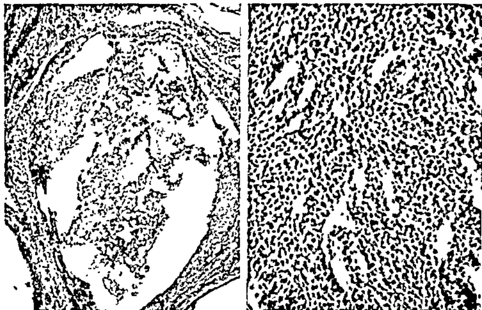


Fig. 425. (*Left*) Hemangio-endothelioma, grade I. A cavernous area made up of erythrocytes and a papillary endothelial growth. (*Right*) Hemangio-endothelioma, grade I. The endothelial cells to a large extent have differentiated into capillaries. (N. D. Smith and A. Broders.)

ENDOMETRIOMA
FIBROMA
BL
MELANOMA
UR.
VAG.

Fig. 426. Illustration of various benign tumors (W. H. Daniel, Los Angeles).

serious nature of this condition is realized when it is noted that of 14 cases in the literature reviewed by Bancroft three died of hemorrhage.

slightly movable and poorly defined, although they may be diffuse. As previously mentioned, this growth is composed of vessels containing lymph. In Chisholm's case the glands of the mucosa were lined by a single layer of columnar cells with no typical proliferation. A fibrous stroma existed in the submucosa which presented a honeycombed appearance. Endothelial cells arranged in a single layer lined the numerous round spaces. Many arterioles and dilated veins were noted throughout.

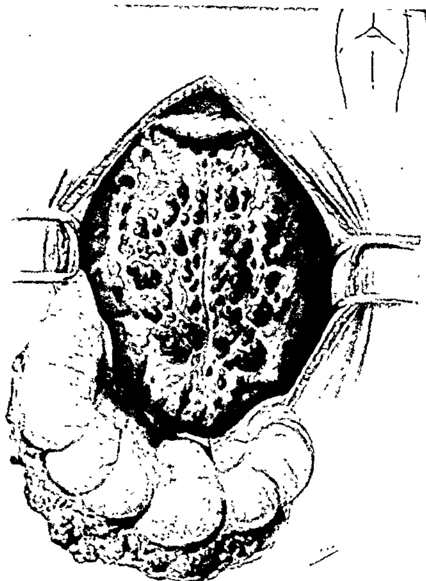


Fig. 424. Cavernous angioma of the rectum and pelvic colon, showing the appearance of the outside of the rectum. (Bensaude: Rectoscopie, Sigmoidoscopie, Paris, Masson.)

Lymphangioma

This variety is even more uncommon than hemangioma. Despite the fact that various treatises on proctology include a brief description of the tumor, the author was able to locate only a few cases occurring in the rectum.[38, 53, 80, 104, 130, 215] Apparently they are of small size, single, soft,

Symptoms. Either variety of angioma

Pathology. A fibroma has its origin in the connective tissue of the submucosa. It is encapsulated, fairly hard in consistency, ovoid in shape and of small size, although it may reach considerable proportions. The tumor may remain in the wall of the rectum or become polypoid and extend into the lumen of the bowel. Ordinarily it is single and of slow growth. Two types may be encountered, the fibromyoma and the fibromyxoma. Both are more common than the true fibroma just described.

Histopathology. Section of the tumor shows varying amounts of fibrous tissue arranged for the most part in wavy bundles. Few blood vessels are noted. The mucous membrane is somewhat hypertrophied.

Symptoms. Either constipation or diarrhea may be cited. An increasing desire for stool with a sense of heaviness in the rectum is not uncommon, while in some cases, especially when the tumor is low-lying, tenesmus may occur. Mucus usually accompanies the evacuation and, if ulceration has occurred, is tinged with blood, though this is the exception rather than the rule. In late cases all the symptoms are exaggerated. Obstructive symptoms may intervene when the growth is of sufficient size to occlude the lumen.

Diagnosis. Although the diagnosis of fibroma of the rectum is seldom made without microscopic examination, the most suggestive finding is the presence of a relatively hard, encapsulated tumor of slow growth, slightly movable, situated usually in the wall and having little tendency to ulcerate.

Myoma

This type of tumor is infrequently met with in the rectum. Of the cases reported, the incidence was slightly greater in women,[119] while the age ranged between 21 and 85.

Pathology. Myomas are supposed to originate in the longitudinal fibers of the bowel, although it is possible that they begin in the muscularis mucosae.[208] They usually occur singly and may be sessile or pedunculated. They may be extrarectal, in which case the growth is usually situated behind the rectum and in front of the sacrum; or it may be intraluminal and protrude into the rectum. The latter type is usually of small size, whereas the former sometimes approaches enormous proportions. Ordinarily the tumor is smooth and hard and the mucosa overlying it is nonadherent.

Histopathology. The tumor is composed of nonstriated muscle fibers interspersed with fibrous connective tissue. As is common, varying amounts of fibrous tissue are present, and, if this is markedly increased in quantity, the growth is termed myofibroma.

Symptoms. The symptoms caused by these tumors are vague and vary according to the size and location of the growth. Constipation is progressive and usually occurs late. Interference with defecation, a sense of heaviness in the rectum and a frequent desire for stool may be experienced. Bleeding is uncommon because the mucosa is seldom ulcerated.

Diagnosis. In the presence of a single, hard mass that is relatively smooth, causing the rectal wall to bulge and making no noticeable change in the nonadherent mucosa, a myoma or a myofibroma must be considered, although a positive diagnosis can be made only by microscopic study.

Treatment. Because of the distressing symptoms and the possibility of obstruction and of the growth's becoming malignant, as has been reported,[202] removal is indicated. Where the myoma is extrarectal, the best procedure is to excise the tumor from without rather than through the rectum.

Lipoma

Also called adipose or fatty tumors, lipomata are comparatively common and occur next in frequency to the adenomata previously described. They are most common in late adult life.

Browne[39] has listed 130 instances of colonic lipomata from the English litera-

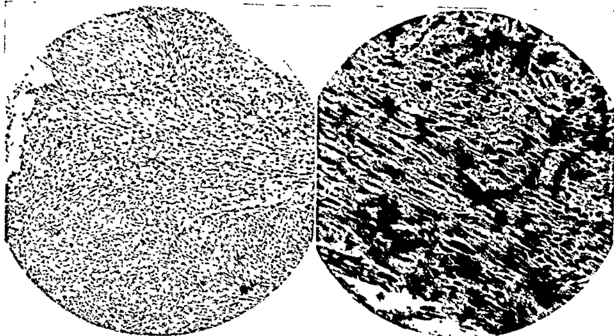


FIG. 427. Leiomyoma (G. H. Thiele).

may be present without giving any indication. Of course this will vary somewhat according to the location of the growth. If the patch is confined to the perianal region the patient will undoubtedly be cognizant of its presence, and the same may be said of a knobby swelling in the anus. One feature in the symptomatology that is of utmost importance is the history of profuse bleeding on one or more occasions over a period of years, the first occurring not infrequently in early youth. At times the quantity that is related as lost may be almost unbelievable. The blood expelled is described as being either light or dark-red and mixed with clots. Tenesmus, where the process invades the anus, and attacks of abdominal pain where the sigmoid is involved may be cited by the patient.

Diagnosis. The diagnosis of these tumors is not always easy even when they are located beside the anal margin. The presence of a soft, well-defined patch of purplish hue is, of course, suggestive. On proctosigmoidoscopy the growth may appear as a localized or diffuse purple mottling, usually with visible points of bleeding without definite ulceration.

Treatment. It is extremely fortunate that these growths are so rare because the treatment is none too satisfactory. Every effort should be made, however, to treat the case conservatively and avoid hemorrhage, which is so frequently fatal. Growths in the anal and perianal regions may respond to injections of boiling water,[293] quininurethane[12] or hypertonic glucose, to the quartz mercury lamp, refrigeration with carbon dioxide and roentgen therapy. Exceedingly good results have been reported following the use of radium. Excision of the growth, followed by the employment of radium rays, has been advocated. Where excision is selected, the angioma should be removed by means of the endotherm or surgical diathermy. Angiomatous involvement of the rectum may be treated with carbon dioxide snow, employing the technic described by Werner for inflammatory stricture (see p. 384), but the treatments should be given for 20 seconds. The formation of a colostomy is a safeguard, inasmuch as traumatism and ulceration are avoided.

CONNECTIVE TISSUE TUMORS

Fibroma

In the rectum and sigmoid this variety of tumor is of rare occurrence, but when encountered it is usually in adults.

increased size and trauma they may give rise to symptoms of partial obstruction and bleeding. Five cases of subacute obstruction in the colon have been described.[150, 163, 184, 205] The literature reveals 20 case reports of spontaneous passage of intestinal lipomata per rectum.[163]

The symptoms cited by Pemberton in his group of cases are shown as follows:

Pain in 75 cases
Palpable tumor in 64 cases
Bleeding in 27 cases
Constipation in 49 cases
Constipation alternating with diarrhea in 13 cases
Diarrhea in 7 cases
Anemia in 7 cases.

Diagnosis. Such tumors of the perianal region are easily diagnosed, although the same is not true when they are located in the ischiorectal fossa, high in the rectum or in the sigmoid. On proctoscopy the presence of a single, pedunculated mass that appears yellowish and smooth, of soft consistency (determined if the tip of the instrument can be pushed against the tumor) and with superficial ulcerations is suggestive, but a positive diagnosis is seldom made except at operation. Abdominal palpation, sigmoidoscopy and roentgenologic examination following a barium enema may detect a growth in the sigmoid region.

Treatment. Ligation of the base and removal may be done where the growth is pedunculated. Incision, enucleation and suture may be employed if the lipoma is confined to the rectal wall or the ischiorectal fossa, while sigmoidotomy or segmental resection is indicated for lipomatous growths in the sigmoid.

Runyeon,[230] in his group of collected cases, has shown the procedures employed for removal (see below):

Paraffinoma or Eleoma

Even though this is not a true tumor, a brief description is appropriate at this time because injections of paraffin oil under the mucosa of the rectum for prolapse, and especially hemorrhoids, have been followed by oil tumors or "eleomata," as they are termed by Rosser.[229] (Fig. 429.) Coalescence of these may give rise to chemical stricture.[227]

Buie[219] and others have discussed these pseudotumors. They are of common occurrence and are noted above the anorectal or pectinate line and in the lower rectum. Ordinarily the mucosa is not freely movable but is quite adherent. One or more areas may be involved. The differential diagnosis is not easy, although a history of previous injections may serve as a valuable aid. When in doubt, a biopsy using a prostatic punch or Turkel needle should be taken. In our experience, a period of time is required for disappearance by absorption, and, because of the symptoms described by the patient and the possibility of a connective tissue tumor with malignant potentialities, it is our custom to remove the eleoma by local excision.

Location of Lipomas in 118 Cases (Runyeon)

Location	Anal Removal	Spontaneous Passage	Colostomy and Resection	Colostomy	Resection	Colostomy	Total
Rectum	10	2	1	—	—	—	13
Sigmoid	3	2	—	2	6	1	14
Descending colon	2	—	—	4	7	1	14
Transverse colon	0	1	—	4	12	—	17
Ascending colon	—	—	—	4	15	—	19
Cecum	—	—	—	14	18	—	32
Presumably in colon . ..	1	7	—	—	1	—	9
Total	16	12	1	28	59	2	118

ture. Additional reports have been cited.[23, 122, 166, 171, 230, 239, 252, 271] In order of frequency they are found in the cecum, ascending and sigmoid colon.

Etiology. Except to mention that irritation and inflammation may play a role in the development of lipomata, little can be said other than to review briefly various theories that have been promulgated. Minelli,[187] for instance, believes that these tumors are the result of degenerated connective tissue, while Cicala[54] suggests that they arise because of perivascular infiltration in the fibrous trabeculae. Aievoli[2, 3, 4] is of the opinion that a deposit of fatty tissue is brought about by maldevelopment in the lymphatic and muscular circulation of the tissues, whereas Borst[35] considers lipomata to be the results of metaplasia of common connective tissue into the adipose variety.

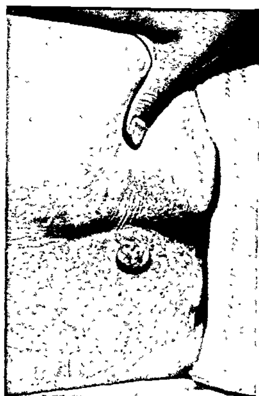




Fig. 428. Lipoma of the perianal region. (*Left*) Author's case. (*Right*) High-power section showing adult-fat cells.

Pathology. Lipomata are soft, smooth, lobulated tumors composed of fat. They usually occur singly and are often movable and pedunculated. The most frequent site is the perianal region, in which case the tumor develops from the subcutaneous tissue. (Fig. 428.) Two varieties of lipomata are described as occurring in the rectum and sigmoid colon: (1) the submucous, which originates in the connective tissue of the submucous layer of the rectum, and (2) the subserous, which has its origin in the connective tissue of the subserosa. They are of slow growth and prone to ulcerate, but seldom undergo malignant change.

Histopathology. These tumors resemble adipose tissue as found elsewhere, except that the color is darker and the cells are somewhat larger than in normal fat. The fatty masses are arranged in lobules and separated by fibrous trabeculae. (Fig. 428.) Usually the vascularity is poor.

Symptoms. Fatty tumors of the perianal region and buttocks usually cause no symptoms unless they become large or irritated. Those confined to the rectum and sigmoid are often symptomless, although because of

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NEUROMA

A neuroma is a tumor containing nerve elements. Such a discussion invites a consideration of the group "neurofibromas," which are composed for the most part of fibrous tissue with varying amounts of intercellular collagen and a few nerve fibers. The last do not appear to increase as the tumor grows. Auerbach's plexus is the apparent source of these tumors in the large intestine. Verocay and Masson[279] believe these tumors to be of neuro-ectodermal origin, arising from the sheath of Schwann. Cushing[66] was of the opinion that they should be considered a sheet of cells such as the mesoderm, which possesses the ability to give rise to a variety of tissues. On the other hand, Penfield[204] describes them as being of mesodermal origin, arising from the epineurium, perineurium and endoneurium of the nerve bundles. Neurofibromas are not commonly situated in the alimentary tract, although the stomach is said to be the most frequent host.[52, 129, 292] As a group, all varieties are extremely rare.

Noss[198] has reported the single case of true neuroma of the rectum. Others,[132, 292] including Woolf[292] and Keith,[132] have cited instances of neurofibroma. C. Smith[245] recently successfully removed a tumor of this type from the sigmoid. In the case reported by Noss, no symptoms were cited. The growth was located in the submucosa and the overlying mucosa was quite intact. Local excision resulted in an apparent cure, as learned from the reporter six years after removal. In all cases of this variety of growth the diagnosis may be difficult without microscopy. That all grades of malignancy may be encountered is well recognized.[57]

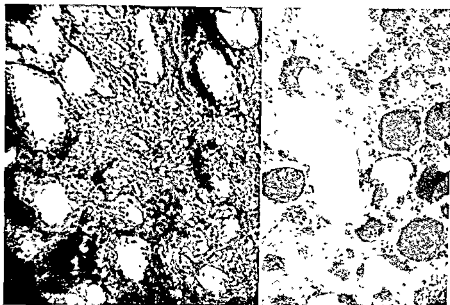


FIG. 429. (*Left*) Eleoma—routine stain. (*Right*) Eleoma stained with Sudan III to reveal presence of oil. (Curtice Rosser.)

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CHAPTER 19—PART 1

Malignancy of the Anus, Rectum, and Sigmoid Colon

The magnitude of the cancer problem is almost inconceivable, but authentic information, compiled from sources such as the official publications of the American Cancer Society, and from the official reports of The United States Public Health Service, are now available. These publications in part state:

"The increase in the number of deaths attributed to cancer during recent decades has aroused widespread interest in this disease and has resulted in an intensification of the efforts to discover its cause. From eighth or ninth in rank among the leading causes of death in 1900, depending on how causes of death are classified, cancer has advanced to second place in 1940, being exceeded as a cause of death only by diseases of the circulatory system. According to available statistics, 500,000, or one-half million, persons in the United States are stricken each year with malignant disease. This toll is a great challenge to medicine today, and the suffering of those who survive and the terrific economic burden imposed on the nation combine to make cancer the most dreaded of all diseases. It has been reported by Lynch[641] that 35,000 deaths occur annually from malignancy of the lower bowel. Yet, in the face of this rather disheartening preliminary, it must be remembered that cancer is a curable disease. Its cure, however, depends on two factors—early diagnosis and radical surgical removal. Pertinent to our discussion, Rankin and Graham[852] only a few years ago remarked: "A study of any statistical data which are available indicates that more patients with carcinoma of the large bowel and rectum are found to survive over a given period of years than with carcinoma of any other portion of the gastrointestinal tract."

Year after year the number of deaths

attributed to cancer has increased, and while the same is true of the population, it is apparently well out of proportion. The rise in the frequency of cancer, according to the Metropolitan Life Insurance Company and other Statistical Survey Commissions, is due more to the decline of the death rate in other diseases than to any increase in the cancer death rate. Certainly a larger number of cases involving the anus, rectum, and sigmoid colon are being recognized, but it is the consensus that this is due to improvements in diagnostic technic and the more widespread use of these methods, together with the fact that patients are better carried over the gaps of intermediary illnesses and therefore reach an age when cancer is more frequent.

In presenting the subject of malignancy in this site, it is of value to offer evidence based on a substantial series of proved cases. For this purpose, and in order to compile data as authentic as possible, the author has selected four groups to support this discussion. These will be designated as A., B., C. and D., as follows:

Group A. Represents the author's personal series of 800 private patients, as of September 1, 1948, with malignancy of the anus, rectum and sigmoid colon.

Group B. Represents a combined series of 712 patients with malignancy of the large bowel (previously reported by W. W. Babcock and the author in 1942)[61] on whom resection was performed without the establishment of any type of colostomy. By far the majority in the group were those of W. W. B.

Group C. Represents a series of 1,995 patients with malignancy of the anus, rectum and sigmoid colon, collected from various hospitals in which the author was associated and from the private records and services of Doctors C. F. Martin, J. B. Carnett, W. W. Babcock and J. C. Howell. As mentioned in earlier editions, a great number were discarded because some necessary data were lacking from the record. This material, with due credit, was reported by the writer[53] in 1934.

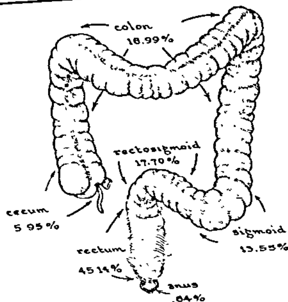


Fig. 430. Incidence of malignancy of large bowel. (Pemberton.)

Group D. Represents a series of 318 patients with malignancy of the anus, rectum and sigmoid colon, all of whom showed metastasis to one or more organs, as evidenced by biopsy, celiotomy, roentgenograms or necropsy. This data was compiled by Gilbert and the author in 1938.[63] Two years later the author[56] cited 48 additional patients or a total of 366, all of whom disclosed metastasis.

INCIDENCE

It has been estimated[943] that approximately 12 per cent of all malignant tumors in the human body originate in the anus, rectum and sigmoid colon and that 80 per cent of all intestinal cancers are located in this region.[1071] This incidence is slightly above the 76.9 per cent reported by Pemberton and Dixon,[791] the 75.2 per cent by the Lahey Clinic group and the 76.5 per cent by Vynalek[1016] from the Hines Veterans' Hospital. According to Mayo,[679] malignancy of the rectum and sigmoid is next in frequency to that of the stomach, while Hill[473] found it equal to that of the uterus.

In a series of 5,714 malignant cases from the radiologic service of the Philadelphia General Hospital, records show the incidence as follows:[1017]

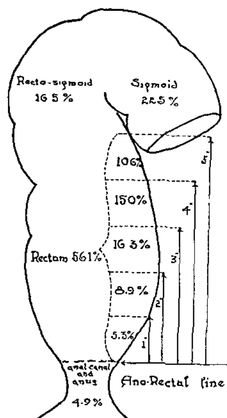


FIG. 431. Diagram showing the percentage of malignant growths in various portions of the rectum and sigmoid.

Site of Cancer	Number of Cases
Cervix	902
Breast	686
Stomach	545
Rectum and sigmoid colon	475
Prostate	293
Larynx and epiglottis	265
Tongue and mouth	254
Bladder	202
Tonsil and pharynx	163
Esophagus	148
Vulva and vagina	110
Testes, scrotum and pelvis	105
All other sites	1,456

It will be noted that cancer of the rectum and sigmoid stands fourth in this series. If malignancy of the breast and of the cervix are omitted, one may rightfully deduce that, in males, cancer of the rectum and sigmoid is next in frequency to that of the stomach.

Site

It is extremely disconcerting to evaluate any statistic survey when basic anatomic landmarks are a source of confusion. Based on the premise that the rectosigmoid is a juncture and not a region, since it represents the union of the sigmoid and rectum, the percentage of malignant growth in this location will obviously differ. Our views concur with Boehme and Hanson[139] in this respect.

In Group C, the most usual site of cancer in this area is in the rectum, as shown by Figure 431.

Location	Number of Cases	Percentage
Sigmoid	315	22.5
Rectosigmoid	231	16.5
Rectal Ampulla	787	56.1
Anus	68	4.9
Total	1,401	100 0

In Group A, the location is shown as follows:

Location	Number of Cases	Percentage
Sigmoid	112	14.0
Rectosigmoid	261	32.625
Rectum	406	50.75
Anal canal	21	2.625
Total	800	100 000

The difference in the proportions of the sigmoidal lesions of Groups A and C is due to the latter group's representing, for the most part, patients on a general surgical and radiologic service, while the former consists of referred private patients.

Circumferential Site. As accurately noted in the ampulla, but excluding those cases totaling 981 which involved the entire circumference, cancerous lesions were about equally divided between the anterior and posterior walls, as charted:

GROUP C

Anterior wall	239
Posterior wall	219
Lateral wall	53
Total	511

Of our 800 cases in Group A, only those of the rectum proper were evaluated according to the site involved. Two hundred and thirteen of the 406, or better than 50 per cent, were circumferential. The balance were distributed as follows:

GROUP A

Posterior wall with or without lateral quadrant	98
Anterior wall with or without lateral quadrant	81
Lateral wall alone	14
Total	193

RACE

The incidence of cancer in the colored race is not marked, although in Group C, it represents 6.1 per cent of the total number of cases.

White	1,874
Colored	121 (6.1%)
Total	1,995

In Group A, the incidence is as follows:

White	767
Colored	33 (4.1%)
Total	800

SEX

It will be noted that the incidence is greater in men than in women, which is consistent with the reports of others.

GROUP C

Males	1,190
Females	805
Total	1,995

The ratio above presented conforms to that in Group A.

GROUP A

Males	419
Females	381
Total	800

AGE

According to age, carcinoma of this region is most frequent between 40 and 70, as shown in the following table compiled from Group C.

AGE	NUMBER OF CASES
10-20	8
21-30	101
31-40	223
41-50	412
51-60	580
61-70	424
71-80	209
81-	38
Total	1,995
Youngest	13
Oldest	91
Average age	54.46

In Group A, the age incidence is appended as follows:

GROUP A

AGE	NUMBER OF CASES
17	1
21-30	25
31-40	76
41-50	155
51-60	260
61-70	171
71-80	103
81-85	9
Total	800
Youngest	17
Oldest	85

While cancer is usually considered a disease of middle or later life, one should not be confused or lulled into a sense of false security by a young patient. Although relatively uncommon, cancer is by no means a rare disease in youth. Below the age of thirty it is here estimated at 5.4 per cent. This is slightly above the average usually found in the literature. For instance, Rankin[848] found the percentage below this age to be 3.85 in a series of 1,452 cases; Brindley[155] placed it at 2 per cent in 100 cases; Wildholz,[1072] 1.95 per cent in 563 cases; Lynch,[636] 7 per cent in 491 cases; Glaser,[402] 3.5 per cent in 527 cases;



FIG. 432. H. L., age 4 years, 7 *months, admitted to hospital* because of rectal bleeding. Examination showed a pedunculated growth. The polyp was removed and sent to the laboratory for routine microscopy. An early malignant process was in evidence, as shown by Figure 433. (Bacon, H. E., Wolfe, F. D., Archambault, R. A.: Am. J. Dis. Child. 64:70.)

Schreiner,[918] 2.6 per cent and Fitzwilliams[337] 11 per cent in an analysis of 210 cases. Phifer[802] collected 49 cases below the age of 20, 22 of which were under 15. Allingham[15] observed a rectal carcinoma at 13, Smith[944] at 11, Garrard[388] at 12, Philip[803] at 9 and another at 12, Clar[221] at 2, and Phifer[802] under 1. In children, Lynch[634, 638] found that 0.5 per cent occurred below the age of 9.

Fowler,[364] in an excellent article on malignancy in persons under 26 years of age, noted that 18.7 per cent of neoplasms were in the large bowel, and of these 12.5 per cent were located in the rectum and rectosigmoid.

Of the two patients whose cases are here reported,[68, 71] one child is still living and clinically free of neoplastic disease ten years after excision; the other child died nineteen months after operation and irradiation. (See sarcoma, page 690.)

Case 1. H. L., a lad of 4 years and 7 months was brought to the Children's Clinic of the Philadelphia General Hospital because of bleeding and protrusion from the bowel. As related by the child's mother, about one and a half years previously, blood was first noticed in the toilet bowl after a bowel movement. During the past year bleeding had been more or less constant following each defecation. About four weeks previously, approximately a teaspoonful of fresh blood was passed, and this situation had persisted until the time of admission.

In his history, mumps, measles, chicken pox, and whooping cough were cited. Both the father and mother were living and well, aged 32 and 29 respectively. No family history of cancer was obtained. On examination a polypoid growth about the size of the distal phalanx of the index finger was found. Double-contrast enema revealed no evidence of path-

AGE INCIDENCE AS COMPILED BY VARIOUS AUTHORS

	Number of Cases	Under 20	20-30	31-40	41-50	51-60	61-70	71-80	Over 80
Pennington[793] (collected cases)	7,174				1,442	2,072	1,783		
Bacon (Group C)	1,995	8	101	223	412	580	424	209	38
Lynch[634] . . .	491	4	32	66	117	136	91	21	7
Cripps[246]	371		3	21	78	93	119	53	4
Yeomans[1071]	320	1	13	38	64	103	74	23	4
Zinner[1078]	201		6	24	50	76	38	6	1
Oehler[763]	230	2	3	13	37	81	67	24	3
Lockhart-Mummery[622]	200		3	10	32	83	58	14	
Finet[348]	321		25	56	86	102	47	5	..

ology in the large bowel. On section some of the glandular components were lined by columnar goblet cells, showing normal maintenance of nuclear polarity. A few, however, exhibited hyperchromatic cell lining accentuated by definite loss of nuclear polarity, assuming pseudostratified and stratified arrangement. Mitotic figures were frequently encountered. Dr. Custer regarded these as evidence of early malignancy. Two other pathologists confirmed this diagnosis.

The urine examination was negative. Blood count showed: erythrocytes, 4,180,000; leukocytes, 7,700; hemoglobin, 78 per cent; differential: polymorphonuclear leukocytes, 50 per cent, lymphocytes, 48 per cent; transi-

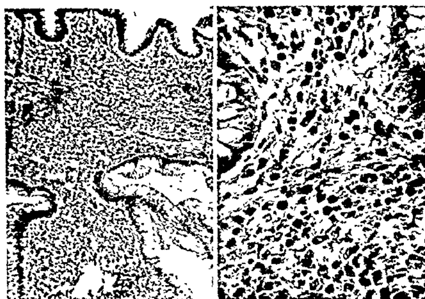


Fig. 433. (*Left*) Low-power section through polypoid growth of rectum. Note the hyperplasia of the acinar epithelium and the inflammatory changes in the stroma. (*Right*) High-power magnification of same specimen, showing poorly defined basement membrane. Some *of the glandular components are lined by columnar goblets cells presenting* normal maintenance of nuclear polarity, while a few exhibit hyperchromatic-cell lining accentuated by definite loss of nuclear polarity assuming pseudostratified and stratified arrangement, mitotic figures being frequently encountered. (Bacon, H. E., Wolfe, F. D., Archambault, R. A.: Am. J. Dis. Child. 64:70.)

Table 46. Frequency of Rectal Cancer in Early Life

Author	Total Series	No of Patients Below 30	Percentage	No of Patients Below 20	Percentage
Matzen[674] (collected cases)	8,054				0.003
Pennington[793] (collected cases)	7,174		0.032		0.005
Rosenberg[579]	4,048				0.002
Bacon, 1934 (collected cases)	1,885	109	5.4	8	0.401
Bacon, 1938 (collected cases)	2,344	113	4.8	10	0.426
Janusz[496]	831				0.0024
Pässler[783]	282		1.0		.
Zinner[1078]	201	6	2.9		. .
Oehler[768]	230	5	2.1	2	0.869
Lockhart-Mummery[622]	200	3	1.5		. . .
Finet[348]	321	25	7.7		. .
Yeomans[1071]	320	14	4.3		. .
Cripps[246]	371	3			0.264

tionals, 2 per cent. Blood sugar was 87 mg. per 100 cc.; blood urea, 14 mg. per 100 cc. The Kahn test was negative.

The growth was removed and the child has been followed periodically since June, 1937. No evidence of recurrence as of 1947.

A review of the literature citing proved cases of anal, rectal and sigmoidal malignancy in patients 19 or under has been reported elsewhere by the author but is here condensed as shown in Table 47.

TABLE 47

	Age	Sex	Location	Symptoms	Duration of Symptoms	Duration of Life	Type of Tumor
Ahfeld[6]	Newborn monster		Rectum				
Clar[221]	3	M	Sigmoid				
Lasnier[595]	3	..	Rectum	....	....	....	Epithelioma
Ullhorn[1003]	3½	M	Sigmoid				
Goodman[412]	4	F	Sigmoid	Chronic constipation	4 weeks	....	Lymphosarcoma
Duncan[309]	5	M	Rectum				
Ullhorn[1003]	5	M	Rectum				
Lockhart-Mummery[621]	8		Rectum				
Philip[803]	9	M					
Steiner[956]	9	M	Sigmoid	Pain in abdomen	2 weeks		
Leijer[601]	9	M	*Sigmoid*	Constipation	11 days		
Parkinson[782]	9	M	Rectum		6 months		
Rowntree[891]	10	M	Rectum		.	....	Sarcoma
Stern[957]	*11*	*F*	Rectum	*Abdominal pain*			
Smith[944]	11	M	Rectum	Bleeding	6 months	....	Adenocarcinoma
Bethe[111]	11		Rectum				
Rankin[847]	11		Rectum	.....	.	....	Lymphosarcoma
May[677]	12	F	Rectum				
Paultauf[786]	12	F	Sigmoid				
Garrard[388]	12	M	Sigmoid	Constipation			
Zuppinger[1080]	12	F	Sigmoid	Abdominal pain	3 months		
Parkinson[781]	12	F	Rectum	Abdominal pain		....	Adenocarcinoma
Marchand[659]	12	F	Anus	Rectal pain	9 months		
Cummings[254]	12	M	Rectum				
Busche[183]	12	M	Rectum	Pain in rectum			
Mayo[687]	12	M	Rectum				
Philip[803]	12	F					
Milne[728]	12	M	Rectum	Intestinal obstruction	Few days	....	Colloid
Mandl[653]	12		Rectum				
Nothnagel[763]	*12*	*F*	*Sigmoid*				
Jordan and Chamberlain[519]	13	M	Rectum	Diarrhea	21 months	....	*Adeno*carcinoma
Czerny[259]	13	M	Rectum	. .	*18 months*	....	Adenocarcinoma
Allingham[16]	13	M	Rectum				
Gurlt[430]	13	M	Rectum				
Gowland[419]	13	M	Rectum				
Kupfelere[575]	13	F	Rectum				
Raiford and Buttles[834]	13	F	Rectum	Lumbar pain	4 weeks	....	Colloid carcinoma
Babcock[37]	13	F	Rectum				

TABLE 47—(*Continued*)

	AGE	SEX	LOCATION	SYMPTOMS	DURATION OF SYMPTOMS	DURATION OF LIFE	TYPE OF TUMOR
DeSaive[283]	13		Rectum				
Bottin[143]	13	F	Rectum				
Rostoker[887]	14	.	Rectum				
Schneider[913]	14						
Philip[803]	14	M					
Mayo-Robson[691]	14		Rectum				
Caird[188]	14						
Davis[273]	14	M		. . .	.		Adeno-carcinoma
Madelung[646]	14		Sigmoid				
Olmsted[769]	14	M	Sigmoid	Abdominal pain and diarrhea	4 months		Adeno-carcinoma
Porter[815]	14						
Cripps[247]	14	M	Rectum		2 months	3 months	Adeno-carcinoma
Israel[493]	14	M					
Michaux[709]	15	M	Rectum	.		.	Colloid
Wilde[1051]	15	M	Rectum				
Marsh[663]	15	M	Rectum	Abdominal pain	6 months	. . . .	Adeno-carcinoma
Bernouilles[105]	15	M	Rectum				
Clogg[226]	15		Rectum				
Porter[815]	15						
Godin[406]	15		Sigmoid				Scirrhous carcinoma
Yeomans[1072]	15	M	Rectum				
Gant[386]	15	F	Rectum				
Fowler, R. H.[365]	15	M	Rectum	Pain in rectum and abdomen	9 months		Adeno-carcinoma
Wilkerson[29]	15						
Philip[803]	15	M					
Rome[877]	15	M	Rectum	Abdominal pain	1 month		Adeno-carcinoma
Schneider[913]	15						
Rostoker[887]	15						
Kaleniewicz[525]	16	M	Sigmoid				
de la Camp[277]	16		Rectum				
de la Camp[277]	16		Rectum				
Gant[386]	16	M	Rectum				
Clark[222]	16	M	Sigmoid	Abdominal pain	6 months	6 months three days	Adeno-carcinoma
Pillon[806]	16	F	Rectum	Abdominal pain	3 months		
Grulee[427]	16	F	Sigmoid	Abdominal pain	.		Adeno-carcinoma
Lazarus-Barlow[599]	16	M	Rectum		. . .	.	Colloid
Porter[815]	16						
Martin, C F.[664]	16	M	Rectum	Bleeding	8 months	15 months	
Rankin and Chumley[846]	16		......		.....	. . . . .	Colloid
Steffins and Burke[954]	17	M	Rectum	. .		....	Colloid
Orr[158]	17	M	Rectum				
Gant[386]	17	M	Rectum				
Gant[386]	17	F	Rectum				
Lawson[598]	17	M	Rectum	Bleeding	7 months	7½ months	Colloid
Senn[925]	17	M	Rectum				
Colwell[243]	17	M	Rectum				
Oehler[768]	17						
Allingham[16]	17	M	Rectum	....	....	....	Encephaloid

TABLE 47—(*Continued*)

	AGE	SEX	LOCATION	SYMPTOMS	DURATION OF SYMPTOMS	DURATION OF LIFE	TYPE OF TUMOR
Foges[359]	17	M	Rectum	.	8 months		
Schoenning[916]	17	F	Rectum	Pain in rectum, bleeding			
Schoenning[916]	17	F	Rectum	Abdominal pain and constipation			
Mathews[673]	17	F	Rectum		2 years	2 years	
Porter[815]	17		Rectum				
Quénu[826]	17	F	Rectum				
Hayden and Shedden[437]	18	F	Rectum				
Gant[386]	18	F	Rectum				
Steffins and Burke[954]	18	M	Sigmoid				
Gant[386] ..	18	F	Rectum			..	Colloid
Lowenberg[630]	18	M	Rectum	Diarrhea	6 weeks	... .	Adeno-carcinoma
Spittler[951]	18	M	Rectum	Constipation, bleeding	3 months	6 months after operation, 10 months after first symptom	Colloid
Billroth[117]	18		Rectum				
Heuck[469]	18	M	Rectum	Constipation, pain in abdomen	17 months		
Hayd[454]	18	M	Rectum	Abdominal pain, bleeding	18 months	. .	Scirrhous
Miles	18		Rectum				Carcinoma
Hastings[451]	18	M	Rectum		4 months	14 months	
Csesch[253]	18	M	Rectum	Bleeding	8 months		Adeno-carcinoma
Cripps[247]	18	M	Rectum		4 months	10 months	
Carnett[196]	18	M	Rectum				
Steffins and Burke[954] .. .	19						
Smith[944]	19	M	Rectum		.	2 years after colostomy	Adeno-carcinoma
Rose[878]	19	M	Rectum	Abdominal pain	2 weeks	4 weeks after onset	
DaCosta[260]	19	M	Rectum	Constipation	4 months		Adeno-carcinoma
Gant[386] .	19	F	Rectum				
Mollière[729]	19	F	Rectum				
Miles	19		Rectum		...	.	Carcinoma
Billroth[117]	19		Rectum				
Dunbar[308]	19	M	Sigmoid	Abdominal pain	2 months		Colloid
Gurlt[430]	19		Rectum				
Phifer[802]	19	M	Sigmoid	Loss of weight and diarrhea	6 months		
Barber[80]	19	M	Sigmoid	Intestinal cramps	1 year		Adeno-carcinoma
Rohde[875]	19	M	Rectum	Bleeding			
Platt[807] .	19	M	Rectum		8 months	Living at end of one year	
Jacobs[495]	19	F	Rectum				
Dieterich, H.[291]	19	F	Rectum	.	.	....	Adeno-carcinoma
Grove[426]	19	M	Rectum				
Kiger[546]	19	F	Rectum				

The symptoms as recorded in 35 cases are given below.

Abdominal pain	17
Bleeding	9
Constipation	7
Rectal pain	4
Diarrhea	3
Lumbar pain	1
Loss of weight	1

The histologic type of tumor was reported in only 37 instances.

Adenocarcinoma	19
Colloid	10
Scirrhous	2
Encephaloid	1
Gelatinous	1
Epithelioma	1
Lymphosarcoma	2
Sarcoma	1

As Rankin has said,[819] the active tissues of youth, instead of resisting invasion of carcinoma, invite its spread, and the young person who is host to malignant neoplasm has little chance for longevity, regardless of the type of therapeutic measures instituted.

Shedden,[931] in a report of 36 collected cases, states that in 25 operation was done, while 11 were untreated. Of these, all except 3 of those operated upon were dead at the end of 24 months, and 25 of the original 36 were dead within 9 months. In our collected series the duration of symptoms at the time of diagnosis, as estimated in 34 cases, was 6.9 months. The average duration of life, as mentioned in 8 cases, was 10 months and 3 days.

ETIOLOGY

In discussing the etiology of malignant tumors we must frankly admit that the essential cause is as yet unknown. Various hypotheses have been propounded, the more important ones of which are worthy of mention. For the sake of clarity, these may be considered under their respective headings, Intrinsic and Extrinsic.

Intrinsic Factors

The Durante-Cohnheim Inclusion Theory,[231, 313] often referred to as the Cell Rest or Embryonal Hypothesis, is founded on the concept that tumors develop from islands of simple or complex cells misplaced during embryonic life, whereas that of Waldeyer and Thiersch is based on the imbalance of tissue equilibrium. The tension theory of Ribbert[867] suggests that cells normally cease to grow, not because of their inability to do so, but because the power of organization and environment is limited. Silver,[933] in a discussion on hormones and cancer, quoted Murphy, who said, "The change from a normal to a malignant cell represents an alteration in the cell itself, by virtue of which, proliferation becomes an automatic process independent of the presence of a continuously acting provocative agent." Kullberg,[572] in advancing a theory of ischemic etiology, stated that the ischemia would represent the intrinsic factor upon which many extrinsic phenomena work to produce malignant growth. It is also a truism, however, that ischemia, of itself, may be the result of extrinsic etiology. Functional cellular activity occurring as a normal process hindered by the presence of ischemia, may adopt a function of unorganized activity and increased energy of growth, despite an altered and depleted blood supply with resultant formation of malignant proliferative processes. The genetic theory, as conceived by Boveri,[147] deals with the accidental transmission of chromosomes in the cells of the somatic tissue, which results in tumor formation. In a review of the chromosomal changes in epidermal carcinogenesis, Biesele[114] asserted that malignancy, once developed, seemed to be a permanent attribute of a cellular population. He further stated that it was important to determine the influence of carcinogen on nuclei and to discover whether the doubling and quadrupling in size of chromosomes which were reported in other forms of malignancy were of like characteristics. Chromosomes were studied by means of the acetocarmine technic in mouse epidermis treated with methylcholanthrene in benzene. Diplochromosomes and even the more greatly enlarged types

were found from the second day on through carcinogenesis, while only normal types were present in the normal and benzene-painted controls and, despite additional paintings, the frequency of enlarged chromosomes remained at approximately eight per cent through the first two months, but later increased to values exceeding 50 per cent in the cancers. Relation of these chromosomal changes to chemical and other genera showed the same increased percentages.

In 1932, Lockhart-Mummery[623, 625] presented his theory of gene mutation of somatic cells, in which it was supposed that mutation of a gene or genes had taken place for excessive rate of division for the tissue of which it is a part. This investigator remarked, "It would seem probable that the growth rate of somatic cells must be controlled by certain genes contained in the nucleus of the cell, and if these genes have been mutated in such a way that the normal rate of growth is increased, i.e., if mitosis of the cell occurs at more frequent intervals than is normal for that particular tissue, then it follows that a tumor must result." In other words, he believed that cancer occurs only in persons who have inherited a genetic susceptibility to mutation of cells in certain tissues. This susceptibility leads to hyperplasia of the cells, and the earliest stage is not cancer, but only excessive proliferation of the cells in a certain tissue. It follows that, by detecting this change in the tissue and dealing with it properly, the patient can be prevented from developing a cancer.

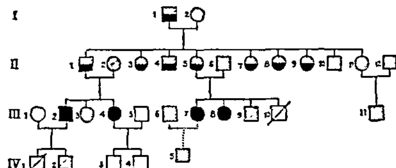


Fig. 434. N. Family. I. (1) Died of cancer, aged forty-two. II. Of nine children, seven died from cancer of the rectum and the other two have not been traced. III. (2) Developed adenomatosis at forty-five. (3) Had not been examined. (4) Developed adenomatosis at forty. (7) Developed adenomatosis at thirty and had colectomy performed; is well today, ten years later. (8) Died of cancer, aged thirty-three. (J. B. Lockhart-Mummery: Diseases of the Rectum and Colon and Their Surgical Treatment, ed. 2, London, Baillière, Tindall & Cox.)

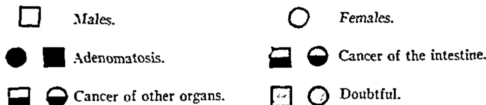


Fig. 435. Key to Figure 434.

Heredity. While it is generally conceded that malignancy is not inherited, clinical investigations indicate that in rare instances the human organism is peculiarly susceptible to tumor formation, even though some exciting factor or factors bear influence. Heredity still has its proponents and will no doubt continue to enjoy their ardent support in view of the evidence produced that cancer is more frequent in those having a cancerous parent than in the population as a whole.[430, 613] The cases recorded by Broca,[157] in which 16 died of cancer in a family of 26 in three generations, and the one reported by Warthin,[1020] in which, of 48 descendants of a cancerous grandfather, 17 died of cancer, are certainly suggestive, if not convincing.

Braund and Binkley,[154] in 1942, in a study of 108 patients reported 31, or 28.9 per cent, giving a history of cancer in 41 relatives, 10 of whom had rectal cancer. Of these, one father had rectal cancer; nine members of the family had other types; three mothers had cancer of the rectum; four had other types. Four brothers had rectal involvement; six had other types and locations. One maternal aunt had rectal cancer; one had malignancy in another location. One each of paternal aunts, uncles, grandfathers and granduncles had had malignant involvement in locations other than the rectum. The above genetic history gave a definite picture of malignancy in 41 blood relatives. Crohn[250] stated that sex is no clue to diagnostic procedures for detection of malignancy. Hereditary tendencies, at least familial tendencies, are likely to be insufficiently stressed. The point was often categorically denied by geneticists in the past. In support of his contention he cited a case of a 32-year-old woman. Both father and mother had had cecal carcinoma. In her own case, the initial radiogram was reported negative, and, mindful of her family history, the attending physician insisted on a second exposure being made. As a result, a well-developed cecal carcinoma was resected at operation. Obviously, a young adult cannot inherit from parents a disease developing later in their lives, but, if a familial trend can be handed down to offspring as a predisposition to acquired malignancy, here is really an instance of inbreeding with a disastrous transmission. Quite recently, a rectosigmoid carcinoma in a grandmother led to investigation of a persistent diarrhea in her grandchild, a young female aged 28. She was discovered to be the bearer of a similar rectosigmoid carcinoma, identical in position and nature. Rosser,[884] Murray,[748] Falk[334] and C. W. Mayo[680] all report familial incidences, mother and son, father and daughter and other blood relations being reported.

Writing on the genetic aspects of the enzyme virus theory of cancer, Potter[818] reported investigators in widely separated fields arriving at substantially the same conclusions on this phase. This was commented on by Claude,[223] who showed that certain particulate components of cytoplasm, called mitochondria, and microsomes are ribonucleoproteins. Potter investigated these entities in terms of the chemical reactions which they promote, the study being devoted to extracellular phenomena. Assuming that this malignant protein, regardless of the origin of its formation, constituted changed enzymatic activity, which was observed by Potter in cancer tissue contrasted with normal tissue, he developed a theory integrating the major important facts concerning cancer. The theory proposed that malignancy was mainly the result of competition between two autosynthetic proteins, i.e., a normal vs. a cancer protein lacking certain specific catalytic properties possessed by the competing normal protein. Cancer protein could be the end result of a variety of processes, e.g., arising spontaneously as a result of a mutation or produced by the action of carcinogenic chemicals or introduced preformed as a virus. Potter referred to the Rouz tumor virus and the Bittner "milk agent" as being distinguished from plasmogens not by origin or action but only

by their transmission, reproductive particles suddenly appearing intracytoplasmically by the action either of mutafacient nuclei or of external carcinogens. Spencer, another investigator,[949] stated that the only carcinogenic agents known to produce malignancy by direct action are certain viruses, which are active solely in the lower order of animals. Laboratory experimentation using chemicals, radium, roentgen rays and other exogenous substances deemed carcinogenic have been tried. A number of these are definitely associated with cancer cell proliferation. Aniline dyes have been known to cause urinary bladder malignancy. In the early days, workers who painted luminous watch dials developed osteosarcoma. The Schneeberg lung cancer is another type. A considerable number of men working in the cobalt mines in Saxony have died of carcinoma of the lung, due to the mechanical irritation brought about by the inhalation of silicon. Benzene is another etiologic agent, used extensively as a solvent. It produces a bone-marrow leukopenia. There is the etiologic concept of pre-existent or concomitant pathology, the importance of which, in the association of cancer with chronic or inflammatory and irritative lesions (precancerous causation), is so close that preventive measures are regarded as being of paramount necessity. Integumental origin of carcinoma is due to lesions antedating the presence of the malignancy, xeroderma pigmentosum being an example of subsequent malignant involvement. It is often present in early infancy. Scars and old burns are etiologic factors, and it has been estimated that approximately 18 per cent of cutaneous cancers on the scalp and extremities develop from these sources. Draining sinuses in chronic osteomyelitis, arsenical and seborrheic keratosis, kraurosis and lupus are additional examples predisposing to cancerous growths in the skin.

Endocrine glands also play a role in producing certain cancers. The relationship between endocrine secretion and prostatic cancer is an indicator of this source of origin, and the administration of estrogens have yielded good results. Discussing this endocrine aspect, Nathanson[751] declared that a wide variety of tumors can be produced or altered in the experimental animal, but these depend on species, strain and individual susceptibility of the animal concerned. He stated that there always seems to be some limiting factor in tumor production in animals in which attempts at production have been unsuccessful. It is difficult, therefore, to translate these observations to the study of the human type of malignancy.

Most of the early investigations concerning hormonal relevancy to cancer relied on indirect evidence, and it was not until isolation and identification of the action of certain sex hormones were perfected that the problem was pursued on a more direct basis. Furthermore, several of the synthetic carcinogenic hydrocarbons were found to be basically similar in chemical structure to cholesterol and to gonadal and adrenal hormones. It was through this that a concept of atypical hormonal metabolism might lead to oncogenesis in animal experimentation. According to Silver,[933] the concept of this hormonal action in cell proliferation production rests on the ultimate division of a single cell, dependent upon its growth to a size at which the volume-surface ratio is such that diffusion of essential constituents cannot adequately reach the interior. If cell growth is dependent on proper functioning and regulatory control of the cell membrane, then it is entirely possible to conceive that a cellular, structural, membranous change, especially one increasing its permeability to water-soluble substances, would so increase the rate of growth that cell division would automatically increase.

Experiments on animals have proved that estrogens in large doses over extended periods have led to the development of both mammary and uterine cervix malignancies, interstitial-cell testicular tumor, pituitary and adrenal cortex growths in mice and uterine fibromyoma in guinea pigs. The

clearest and most dramatic demonstration of hormonal relevancy to malignancy has been the proving of testicular relationship to prostatic carcinoma. Carcinomatous or sarcomatous growths resemble normal development in that both of them show increases in absolute protein content. It is postulated that the pituitary and thyroid hormones act in some manner as regulators of protein anabolism and catabolism and that any defection in the process permits unrestrained malignant growth. A concomitant approach to the problem issues from conceptual ideas of protein metabolism in viral diseases and the virus-induced tumor growths. Carcinoma produced in rabbits by the Shope rabbit papilloma places the virus theory in a much stronger position, especially if the view is accepted that the virus-protein molecule acts as a template for cell protein production.

The fact that human urine contains relatively large amounts of androgens and water-soluble estrogens led to investigation of the excretion as a source of steroid carcinogenic substances. A butyl alcohol extract of urines previously extracted with benzene produced 18.7 per cent of tumors, and carcinogenic fractions have been extracted from normal human urine, as well as from urine of those affected with malignant growths. Silver further quoted Carrel as stating: "The substances that restrain multiplication (of malignant cells) are lipoids in sera and tissues." The most widely known agent, one that has been successfully used in some cases, is colchicine. This inhibits cellular growth (arrest of division), due to its being an unsaturated sterol with a phenanthrene skeletal formation.

Reimann,[899] in a discussion on the causative factors in cancer, stated that various etiologic agents may operate to produce cancer in any or all parts of the body arising from all varieties of tissue. He quoted Mottram as stating that carcinogens produce changes in even unicellular organisms (Paramecia) leading to behavior and morphologic characteristics comparable to cancer cells. The biologic manner in which normal cellular elements grow into definite patterns and the way these patterns are disrupted by malignant invasion have been more or less pure hypotheses and still remain so. The cellular theory in its classical form is no longer a generalization but is descriptive of special cases, i.e., numerous competent organisms possessing nuclei and having no cell well, such as the siphonaceous algae. If protoplasm is continuous intraorganically, then cellular division should be a concomitant characteristic. Accepting the above viewpoint, examination of a malignant tumor shows that cellular multiplicity occurs extracellularly, e.g., not within the frame of the organism. The cells do not organize at all, in the sense in which the word is used. There is something radically wrong in the way cancer cells differentiate, as very often they assume high degrees of specialization, but this is not at all due to interorganic control, but to extracellular activity. Multiplication is not a causative factor of differentiation in normal cells, for this takes place in many instances without it. Therefore, the blame for improper differentiation of malignant cellular elements should not be attributed to multiplication. Malignancy, per se, is not a disease of cellular multiplication, unless future evidence decides otherwise.

Probably the most specific growth which may occur with significant frequency in the same family, the liability of which is certainly inherited, is cancer of the rectum superimposed on intestinal polyposis. In discussing the influence of heredity, Versé[1008] comments as follows: "These polypoid growths are the result of an inherited constitutional predisposition to epithelial tumors of the intestine." Dukes quotes Wechselmann,[1031] who continues: "the disease runs in certain families, being inherited as a Mendelian dominant, and it almost invariably ends in cancer of the intestine." Dukes sums up and states: "Cancer is not inherited, although it is acknowledged that a tendency to epithelial proliferation with

polypi and later carcinoma is inherited." Two case pedigree charts supportive of these remarks are noteworthy. (Figs. 434, 436.)

Extrinsic Factors

In the germ theory as conceived by Gye,[433, 434] some parasite or infective agent is held responsible. This was verified in some cases by the experiments of Bullock[178, 179] and Fibiger.[316, 317] That parasites, by their activity, increase the susceptibility of normal cells to cancer has been mentioned by Adami.[5]

Virchow's irritation theory[1010] is still generally accepted. It must be admitted that it does play an important role in many, or at least some instances, even though it fails to explain the manner in which normal cells are converted into the malignant type or the formation of tumor tissue. McFarland,[696] whose opinion is authoritative, discusses irritation as an etiologic factor as follows: "The theory that the origin of cancer was to be found in chronic irritation, having been laid aside during a generation or so, has emerged with an importance enhanced by increased confirmatory clinical data, and by impressive experimental demonstrations." So far as cancer of the rectum is concerned, chronic irritation should be considered a predisposing cause.

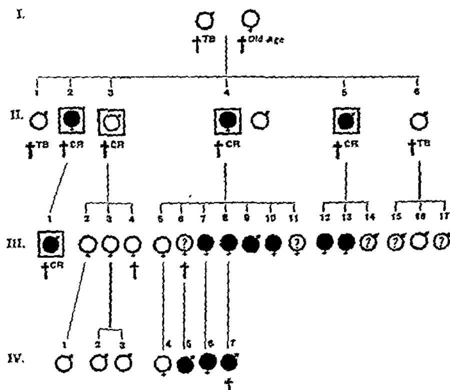


Fig. 436. Jüngling's case, 1928 (Reference 37). (No. 6 in generation III was either a case of tuberculosis of the colon or cancer of the colon.) (Dukes: The hereditary factor in polyposis intestini, or multiple adenomata, Collected Papers, St. Mar's Hospital, London, Lewis.)

According to Maud Slye,[949] there are two factors necessary for the production of carcinoma, the inherited susceptibility and irritation. Under this heading, benign growths such as simple primary adenomata take a leading role. When an authority such as Lockhart-Mummery[617] considers an adenoma of the rectum as a definite precancerous condition, it is certainly just cause for the proper evaluation of the importance of these tumors. This view is also supported

by Buie, who remarks, "That these polyps undergo certain changes which result in full-grown adenocarcinoma of the rectum and colon is no longer debatable." The recent edition of Lockhart-Mummery's work does not include adenomata under benign tumors, but describes them as an individual class "Precancerous Tumors." The life history of these rectal adenomata is worthy of more than cursory mention and, as described by him, is divided into four stages, as follows:

FIRST STAGE. Localized patches of hyperplasia invisible to the naked eye but discoverable with the microscope, affecting an extensive area of the bowel.

SECOND STAGE. The appearance of a crop of sessile adenomata scattered over as wide an area as was affected by the initial hyperplasia. (Fig. 437.)

THIRD STAGE. The development of cancer, either in one of these pre-existing adenomata or in the neighboring epithelium. (Fig. 438.)

FOURTH STAGE. The progressive enlargement and dissemination of the malignant tumor, accompanied by retrogression of the hyperplastic changes and benign tumors surrounding the malignant growth.

Crohn,[250] in 1945, stated that no single factor is more momentous than the presence of adenomatous polyps, single or multiple, or a well developed generalized polyposis, particularly the congenital type. Klemperer, according to the author, found them an extremely common occurrence, affecting 21.5 per cent or more of the so-called normal colons, and found that any large bowel polyp is susceptible to carcinomatous degeneration, particularly if it were situated at a point of greatest mechanical friction, such as the rectosigmoid angle or in the rectum.

As early as 1775, Potts first postulated carcinogens as an etiologic cause of cancer, irritation present in chimney sweeps from soot being blamed for their causation. Years later, according to Reimann, who has been quoted elsewhere, experiments with soot, tar, etc., led to the experimental production of this type of malignancy in 1915. The cholesterol series is another etiologic extrinsic factor and methylcholanthrene has also been mentioned.

As to virus etiology, they have been known to produce (1) chicken sarcoma;



FIG. 437. Local hyperplasia leading to adenoma. This degree of epithelial proliferation reveals itself as minute, rounded elevations on the surface of the bowel, just visible to the naked eye. (J. P. Lockhart-Mummery: Diseases of the Rectum and Colon and Their Surgical Treatment, ed. 2, London, Baillière, Tindall & Cox.)

(2) papillomas in wild rabbits and cancer in the tame variety; (3) frog cancers and (4) possible mammary tumors in mice, since there are indications that the "milk agent" possessed viral properties. Certain types of warts and condyloma have been assumed to be of viral origin. As to chemical sources, a chemistry of the tumor cells themselves, dynamic chemistry and the physics of normal and cancer cells in which the key subject is intracellular metabolism, and various other chemical considerations have been investigated as sources of malignancy. Crohn[250, 251] found sigmoid neoplasms often coexistent with diverticula as an independent process. Hemorrhoids have been reported as causative etiologic factors. Trauma to the rectal mucosa incident to constipation and the passing of hardened feces has been more or less discarded as a cause, since normally the rectum does not serve as a storehouse for feces, as shown by Hurst[466] and Pruitt.[821] The presence of foreign bodies has been referred to frequently, but the cases that can be explained on this basis are comparatively few.

Miller[724] believed that leukoplakia was an etiologic factor, found sometimes pre-

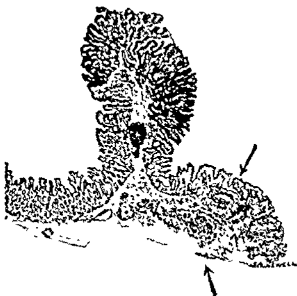


FIG. 438. Malignant disease commencing in adenoma of the rectal mucous membrane. The malignant change is limited to the top and one side of this tumor, but cancer cells are to be seen also invading the submucosa (indicated by the arrows). (J. P. Lockhart-Mummery: Diseases of the Rectum and Colon and Their Surgical Treatment, ed. 2, London, Baillière, Tindall & Cox.)

ceding squamous-cell cancer of the vulva, rectum and the anal canal. Keyes[544] believes that the etiology of this type of malignancy is unknown. He stated that habitus may be a factor in causation, indicated by the relative frequency of its occurrence in females as compared to males. Anal leukoplakia will indicate, and sometimes precede, anal squamous-cell cancer, but Keyes did not consider this a cause. Lues venerea, trauma and infection he found sometimes suspected of being contributive factors, but these cannot be proved as primary causatives. The Mayo Clinic reported that 1 in every 100 cases of hemorrhoids showed histologic evidence of malignancy. In one growth extirpated by Keyes, the tumor possessed histologic evidence of both squamous cellular elements concurrent with adenocarcinomatous growth in different portions of the excised specimen.

Cattell and Williams[205] reported the presence of a previous condition of chronic irritation due to irradiation in cases reported by them of epidermoid carcinomata of the rectum and also the anal canal. The author quoted Hankin's three cases of anal epithelioma in which three positive Wassermann reactions were reported and stated that it was thought that syphilis may be an etiologic agent.

Regarding anal malignancy, the evidence appears convincing that cicatricial tissue resulting from innocuous lesions of this region may serve as an inciting factor. Several lucid reports on this subject are available.[172, 880, 882, 917]

TABLE 48. MALIGNANCY COINCIDENT WITH OR SUPERIMPOSED ON BENIGN ANAL PATHOLOGY

Author	No. Cases	Benign Pathology
Rosser[880]	4	Hemorrhoids
Buie & Brust[172]	19	Hemorrhoids
Christen[217]	1	Hemorrhoids
Csesch[253]	1	Hemorrhoids
Gibbes[396]	1	Hemorrhoids
Hertzler[467]	1	Hemorrhoids
Howe[453]	1	Hemorrhoids
Hirschman & Rosenblatt[478]	1	Hemorrhoids
Heyd[470]	1	Hemorrhoids
Plisson[808]		Hemorrhoids
Yeomans[1071]	1	Hemorrhoids
Lescale[604]	2	Hemorrhoids
Thiele[987]	1	Hemorrhoids and papilla
Hibshman[472]	1	Hemorrhoids
Hill[474]	1	Hemorrhoids
Tucker & Hellwig[994]	4	Hemorrhoids
Keyes[543]	7	Hemorrhoids or condylomata
Broders & Smith[140]	1	Hemorrhoids
Keyes[543]	5	Abscess or fistula
Tucker & Hellwig[994]	1	Fistula
Rosser[882]	7	Fistula
Buie & Brust[172]	8	Fistula
Pennington[791]	1	Fistula
Murray[747]	1	Fistula
Moon[732, 733]	1	Fistula
Mechling[703]	2	Fistula
Murietta[744]	3	Fistula
Lynch[637]	1	Fistula
Landsman[589]	1	Fistula
Kraker[560]	1	Fistula
Kallett[526]	1	Fistula
David[265]	1	Fistula
Campbell[191]	1	Fistula
Saphir[999]	1	Fistula
Yeomans[1068]	1	Fistula
Fitchet[355]	1	Fistula
Rainey[835]	[illegible]	[illegible]

TABLE 48—(*Continued*)

AUTHOR	NO. CASES	BENIGN PATHOLOGY
Hibshman[472]	1	Fistula
Binkley[133]	1	Fistula
David & Loring[271]	1	Fistula
Buie & Brust[172]	1	Fissure
Murietta[744]	3	Fissure
Hill[474]	1	Fissure
Tucker & Hellwig[991]	1	Fissure
Mechling[703]	2	Chancre
Buie & Brust[172]	1	Kraurosis
Hibshman[472]	1	Pruritic Skin
Brofeldt[161]	3	Leukoplakia
McCray[695]	1	Imperforate anus
Keyes[543]	1	Leukoplakia
Buie & Brust[172]	2	Abscess
Buie & Brust[172]	2	Condyloma
Keyes[543]	1	Syphilitic condyloma
Ewing[323]	1	Condyloma latum
Murietta[744]		Lymphogranuloma venereum
David & Loring[271]	2	Lymphogranuloma venereum
Binkley[133]	8	Lymphogranuloma venereum
Cardwell & Pund[193]	1	Lymphogranuloma venereum
Hibshman[472]		Lymphogranuloma venereum
Lisa[609]	1	Lymphogranuloma venereum
Rosser[882]	2	Cryptitis and papillitis
Buie & Brust[172]	1	Prolapse

Several years ago, Dr. Mary Spears and the author collected 13 cases from our clinic at the Graduate Hospital. During the past decade 16 additional cases have been observed.

Malignancy superimposed on hemorrhoids	14
Malignancy superimposed on fistula	8
Malignancy superimposed on anal wart	1
Malignancy superimposed on leukoplakia	1
Malignancy superimposed on fissure	2
Malignancy superimposed on procidentia	2
Malignancy superimposed on l.v. esthiomene	1

NUCLEAR FISSION AND ITS MEDICAL AND SURGICAL SIGNIFICANCE IN RELATION TO CANCER

The more recent development of the artificial type of radioactivity has undergone intensive application to biologic research. The cyclotron also has come into prominence due to recent experiments on the animals surviving the expedition to Bikini Atoll. Briefly stated, the resultant effect is the production of ionization in tissues by direct collision with atomic nuclei, the reaction being comparable to deep roentgen therapy. The therapeutic effect of artificial radioactive isotopes produced by neutron bombardment is now a recognized procedure in treating certain diseases, among them malignant growths. It is much too early, however, to state with any degree of definiteness that this method of treatment permanently removes any of the types of cancer. While isolated instances of the prevention of "takes" in mouse sarcoma have been reported, together with growth regression when the tumor was injected with various boron compounds and then irradiated by bombardment from these cyclotron emanations, no significant inference may or should be drawn from these facts. Preconceived theories relevant to malignancy, should not be made to fit the facts in any problem of research until all of them are finally correlated into a coherent unity, a coordinated, interrelated whole that proves or disproves final destruction of cancer in all cases. Those interested are referred to the article by Cohen,[230] Zahl, Cooper and Dunning,[1076] and the article by Ann Reinhart.[862] In closing these remarks, the author wishes to state that the only pertinent departure from procedures making use of high voltage roentgen irradiation of cancer and that using the products of nuclear fission was the elimination of the protection of surrounding tissues from emanations in the latter method, the entire body surface of the animal being exposed to the identical extrinsic energy as the tumor itself. Due to this phenomenon, a high ionization differential was set up between the tumor and the remainder of the body.

PRIMARY MULTIPLE MALIGNANCY

The existence of one or more malignant growths occurring independently of each

other has been recognized since Billroth[116] published his first report in 1869. Such growths were considered extremely rare but their occurrence has passed from the stage of a pathologic curiosity to one of a well established entity.

The postulates laid down by Billroth, which must be fulfilled before multiple carcinoma can be identified as independent lesions, are well known because they have been mentioned by virtually every writer on the subject, but here again they bear repetition:

(1) The two growths should differ histologically in a manner so pronounced as to exclude the possibility that they are of the same origin but in different stages of development; (2) each growth must spring from its parent epithelium; and (3) each growth must be held responsible for its separate group of metastases.

To this Mercanton[707] added the following qualification: "that if after removal of two carcinomas the patient remains free from the disease, the two growths must have been independent else there should have been other metastasis." It is evident that in carcinomas arising from the intestinal epithelium the first of these postulates cannot well be satisfied, because, as Thompson[988] has said, "Since carcinomatous degeneration of multiple intestinal polypi is entirely likely, it seems that this postulate need not be fulfilled in identifying multiple independent carcinomas of the intestine." As a matter of fact, Bunting[180] is of the opinion that these postulates were intended to apply only to malignant growths arising in different organs.

It is admitted that the limitations of these criteria are too strict because a falsely low incidence has resulted. What then are the criteria which one is to employ? The fundamental problem is "What constitutes primary multiple malignancy?" Tumors arising independently of antecedent tumor growth are known as primary tumors. Whereas a mutation for tumor usually occurs in a single group of cells—unicentric origin, it cannot be denied that it does occur occasionally in several groups of cells—multicentric or pluricentric origin. This is understood to mean more than one malignant growth occurring independently in the same individual. For this there are excellent examples such as polyposis of the large bowel and stomach, lymphosarcoma and multiple myeloma.

The question arises, should these growths be histologically distinct and heterogeneous? It is generally agreed that two tumors which are distinctly different histologically are independent, but it does not necessarily follow that histologic similarity represents one parent tumor from which the other has sprung. We know that sarcoma and carcinoma or the mixed type of carcinoma sarcomatodes, early stressed by Virchow, does occur. Probably this is the result of some abnormal stimulus acting on the epithelial and mesodermal elements for which there is some evidence. The investigations of Ehrlich and Apolant[321] which resulted in the production of a typical sarcoma following the repeated inoculation of mice with a typical adenocarcinoma are worthy of mention, as are those of Russel,[894] who succeeded in obtaining a pure sarcoma after continuous growth of an adenocarcinoma of the breast in a mouse. These experiments were confirmed by Foulds.[362] Others have cited their investigations.[499, 562, 629] Haaland,[435] too, propagated a slow-growing adenocarcinoma in a mouse which exhibited sarcomatous change. According to Major[650] this change is controlled almost entirely by the time element, inasmuch as where the transplanted carcinoma is removed early and transmitted to another animal of the same species, carcinoma results; but if the transplanted carcinoma is permitted to grow until it becomes sarcoma, then all animals injected develop a pure sarcoma. One may recall the case cited by Kidner[545] where a carcinoma developed in the operative scar after removal of a sarcoma.

There has been much discussion as to whether one malignant growth has an inhibi-

tory influence on the development of another primary neoplasm in the same individual. According to Lockhart-Mummery,[626] there seems to be sufficient clinical evidence to show that one malignant growth does inhibit such development, and Dukes[306] has cited some interesting experiments in animals in an attempt to prove that transplantation of a part of the original malignant tumor to healthy tissue elsewhere in the body tends to cause disappearance of the primary neoplasm. Others[1025] are equally firm in their belief that immunity is not conferred, or that one primary malignant growth does not inhibit the development of another. It has been asserted by Cramer,[244, 243] and also postulated in an editorial in the Lancet[315] that an antagonism exists in the development of cancer in two different organs, i.e., development of cancer in one site may act to inhibit the development of malignancy elsewhere in the body. Moreover, this theory has been broadened to include all persons in a homogeneous population group. In its expanded form, the theory postulates that an increase in the incidence of malignancy in one particular organ in one individual of a group due to a direct effect will be followed by a decrease in the incidence of cancer in other organs or tissues among other members of the group. The result will be that, while the relative rank of cancer of the separate primary sites may change, the total incidence of malignancy in cellular sites will remain unaltered. Indeed, one writer has proposed that skin tumors be induced artificially, since these can be fairly readily counteracted and cured in expectation that the incidence of the more fatal types of malignancy will be thereby reduced.[790]

In accordance with this theory, an experiment was carried out by several investigators, using the mouse as a medium and, although some of the early procedures were subsequently interpreted as confirming the theory, later experiments using a larger number of mice have failed to confirm it.[140] Rather pertinently, the data in this study

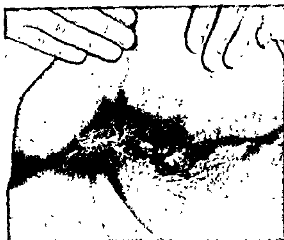


Fig. 439. Carcinoma superimposed on *hemorrhoids*.

also fail to confirm the theory as applied to human populations, as the known increase in the incidence of cutaneous cancer, instead of decreasing incidence of malignant growths in other sites, has definitely increased the total incidence of cancer. Furthermore, not only are malignant neoplasms of the skin relatively more frequent among southern residents, but genito-urinary involvement among white males and also females is much higher among them, and, until more tangible and reliable supportive evidence for the contention may be presented, this theory of antagonism in cancer development in two different organs is essentially invalid in its premises.

As to the occurrence of these growths, statistics show that they are more common in organs unrelated by any system. By means of breeding experiments on mice, Maud Slye[941] has shown that spontaneous cancer is inherited as a Mendelian dominant. Indeed, her work is impressive in that there is probably a susceptibility to tumor formation in individuals developing multiple malignant growths and because these are not limited to any organ or portion of the human body. There seems to be little significance as to the distinction between synchronous and metachronous growths. As Eliot has said, "There is no reason why more than one glandular organ should not

be exposed to the exciting cause of carcinoma, whatever that may be, either at about the same time or many years later." So far as metastases are concerned, all would tend to produce those of the same tact, a detached fragment of the primary lesion being engrafted onto another portion of the mucous membrane. In such, a marked variation in the histologic appearance would not be expected, inasmuch as they arise

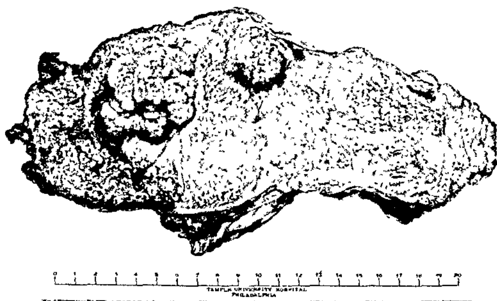


FIG. 440. A. C., age 72. Bowel specimen showing two lesions representing "kiss" or "contact" carcinoma.

type but in different locations. The opinion is fairly universal that, taking all phases into consideration, the various factors point to some general change as the predisposing cause of multiplicity.

Secondary tumor formation was accredited to the existence of a continuous network in the submucosa of the bowel[442] but this since has been disproved.[212, 603, 717, 731] The occasional transmission of cancer by retrograde venous embolism has been cited also. Even though they may appear similar, secondary growths should not be confused with multiple primary malignancy.

It is recognized that an implantation type of cancer does exist, many authentic cases of which have been reported.[731] Such may occur from one labia to the other or from one side of the anus to the other as recently encountered by the writer. Growths limited to a small portion of the bowel such as the sigmoid or rectum may occur by direct contact from the same type of epithelium. It is obviously difficult to determine their exact status. Where the arboral growth is the younger or where the two tumors are situated out of contact with each other or possibly when a prolonged period of time separates the appearance of the two neoplasms, they must be considered both primary neoplasms.

In order to obviate a falsely low incidence of multiple primary malignancy, there has been a tendency to liberalize the original requirements. Those suggested by Warren and Gates[1023] seem logical and are here cited, "Each of the tumors must present a definite picture of malignancy; each must be distinct, and the possibility of one being a metastasis of the other must be excluded." In other words, as Cokkins has said, a good rule to follow is that if two malignant tumors coexist or follow each other, and it can be definitely established that one is not a

metastasis of the other, they must be regarded as primary growths.

The incidence of multiple primary malignancy is variously estimated between 0.6[115] and 6.0 per cent[1024] of malignant autopsies. Berson and Berger[101, 106] cite the necessity of thorough examination before operation and careful exploration when the abdomen is opened. They remark, "Unquestionably, many poor results can be attributed to the fact that a second lesion was missed." Norbury[760] feels that a number of cases of so-called recurrence after operation are really due to the presence of another primary lesion, for such a tumor may be a benign adenoma at the time of the original operation which subsequently exhibits malignant changes.

A number of instances of double primary malignancy of the anus, rectum and sigmoid colon—and of malignancy in these regions associated with malignancy elsewhere in the body have been reported.[51]

TABLE 49. DOUBLE MALIGNANCY IN THE ANUS, RECTUM AND SIGMOID COLON

AUTHOR	SITE	SITE
Graham[420]	Rectum	Rectum
Kraske[562]	Rectum	Anus
Bargen & Rankin[85]	Rectum	Sigmoid
Morton[739]	Rectum	Sigmoid
Bargen & Rankin[85]	Sigmoid	Sigmoid
Bargen & Rankin[85]	Rectum	Rectum
Bargen & Rankin[85]	Rectum	Rectum
Bargen & Rankin[85]	Rectum	Sigmoid
Bargen & Rankin[85]	Rectum	Sigmoid
Hochenegg[480]	Rectum	Rectum
Robson & Knaggs[874]	Rectum	Rectum
Abel[2]	Rectum	Pelvic colon
Abel[2]	Rectum	Rectum
Lockhart-Mummery[626]	Rectum	Sigmoid
Lockhart-Mummery[626]	Rectum	Sigmoid
Norbury[761]	Rectum	Rectum
Miller[726, 727]	Sigmoid	Sigmoid
Morgan[736]	Rectum	Sigmoid
Papin[813]	Rectum	Rectum
Rotter[888]	Rectum	Rectum
Rotter[888]	Rectum	Rectum
Rotter[888]	Rectum	Rectum
Rotter[888]	Rectum	Rectum
Rotter[888]	Rectum	Rectum
Graham[420]	Recto-sigmoid	Sigmoid
Graham[420]	Rectum	Recto-sigmoid
Cole[235]	Rectum	Pelvic sigmoid
Kirshbaum & Shively[552]	Rectum	Sigmoid
Kirshbaum & Shively[552]	Rectum	Sigmoid
Schweiger & Bargen[921]	Rectum	Sigmoid
Schweiger & Bargen[921]	Rectum	Rectum
Schweiger & Bargen[921]	Rectum	Recto-sigmoid
Schweiger & Bargen[921]	Rectum	Sigmoid colon
Schweiger & Bargen[921]	Rectum	Rectum
Schweiger & Bargen[921]	Rectum	Rectum
Schweiger & Bargen[921]	Rectum	Sigmoid
Schweiger & Bargen[921]	Rectum	Sigmoid
Schweiger & Bargen[921]	Rectum	Sigmoid
Silvers[934]	Sigmoid	Sigmoid
Mider[710]	Rectum	Rectum
Mider[710]	Rectum	Rectum
Mider[710]	Rectum	Sigmoid
Mider[710]	Rectum	Sigmoid
Mider[710]	Rectum	Sigmoid
Mider[710]	Rectum	Sigmoid
Mider[710]	Rectum	Sigmoid
Schneider[914]	Rectum	Sigmoid
Burnett[182]	Rectum	Sigmoid
Mider[710]	Rectum	Sigmoid

TABLE 50. THREE OR MORE MALIGNANT LESIONS

AUTHOR	SITE	SITE	SITE	SITE
Lane[591]	Rectum	Sigmoid	Breast	
Norbury[761]	Rectum	Sigmoid	Transverse colon	
Dowden[302]	Rectum	Sigmoid	Small intestine	
Maingot[648]	Rectum	Sigmoid	Anus	
Bargen & Rankin[85]	Three separate carcinomas of the rectum and sigmoid			
Bargen & Rankin[85]	Rectosigmoid	Rectum	Rectum	
Schmidt[911]	Rectum	Rectum	Sigmoid	
Angevine[19]	Rectum	Rectum	Anus	
Zimmerman[1077]	Rectum	Sigmoid	Left adrenal	
Doering[299]	Rectum	Rectum	Hepatic flexure	

be exposed to the exciting cause of carcinoma, whatever that may be, either at about the same time or many years later." So far as metastases are concerned, all would tend to produce those of the same tact, a detached fragment of the primary lesion being engrafted onto another portion of the mucous membrane. In such, a marked variation in the histologic appearance would not be expected, inasmuch as they arise

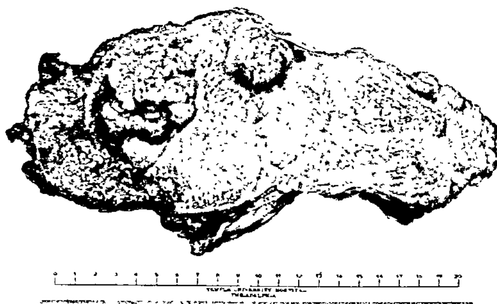


FIG. 440. A. C., age 72. Bowel specimen showing two lesions representing "kiss" or "contact" carcinoma.

type but in different locations. The opinion is fairly universal that, taking all phases into consideration, the various factors point to some general change as the predisposing cause of multiplicity.

Secondary tumor formation was accredited to the existence of a continuous network in the submucosa of the bowel[442] but this since has been disproved.[212, 603, 717, 731] The occasional transmission of cancer by retrograde venous embolism has been cited also. Even though they may appear similar, secondary growths should not be confused with multiple primary malignancy.

It is recognized that an implantation type of cancer does exist, many authentic cases of which have been reported.[731] Such may occur from one labia to the other or from one side of the anus to the other as recently encountered by the writer. Growths limited to a small portion of the bowel such as the sigmoid or rectum may occur by direct con-

from the same type of epithelium. It is obviously difficult to determine their exact status. Where the arboral growth is the younger or where the two tumors are situated out of contact with each other or possibly when a prolonged period of time separates the appearance of the two neoplasms, they must be considered both primary neoplasms.

In order to obviate a falsely low incidence of multiple primary malignancy, there has been a tendency to liberalize the original requirements. Those suggested by Warren and Gates[1025] seem logical and are here cited, "Each of the tumors must present a definite picture of malignancy; each must be distinct, and the possibility of one being a metastasis of the other must be excluded." In other words, as Cokkins has said, a good rule to follow is that if two malignant tumors coexist or follow each other, and it can be definitely established that one is not a

TABLE 51—(*Continued*)

AUTHOR	SITE	SITE
Schweiger & Bargen[921]	Sigmoid	Cecum
Schweiger & Bargen[921]	Rectum	Cecum
Schweiger & Bargen[921]	Recto-sigmoid	Cecum
Schweiger & Bargen[921]	Rectum	Ascending colon
Schweiger & Bargen[921]	Rectum	Cecum
Saltzstein, Kelly[897]	Recto-sigmoid	Transverse colon
Hellendall[461]	Sigmoid	Appendix
Herrlin, Mersheimer[465]	Sigmoid	Cecum
Davis[272]	Rectum	Pylorus
Bull[177]	Sigmoid	Stomach
Bull[177]	Sigmoid	Stomach
Mider[710]	Sigmoid	Descending colon
Mider[710]	Rectum	Transverse colon
Mider[710]	Rectum	Cecum
Mider[710]	Rectum	Descending colon
Mider[710]	Rectum	Splenic flexure
Mider[710]	Rectum	Cecum
Mider[710]	Splenic flexure	Descending colon

TABLE 52. MULTIPLE MALIGNANCY OF THE LOWER INTESTINAL TRACT AND GENITO-URINARY SYSTEM

AUTHOR	SITE	SITE
Bilz[118]	Sigmoid	Uterus
Hanlon[443]	Sigmoid	Uterus
Lockhart-Mummery[620]	Rectum	Uterus
Fried[369]	Anus	Cervix
Warren & Gates[1025]	Rectum	Cervix
Warren & Gates[1025]	Rectum	Cervix
Hanlon[443]	Rectum	Fallopian tube
Scharlieb[907]	Rectum	Both ovaries
Gouillioud[418]	Sigmoid	Ovary
Rau[853]	Rectum	Ovary
Tanberg[983]	Rectum	Kidney
Hanlon[443]	Rectum	Kidney
Hanlon[443]	Sigmoid	Kidney
Bilz[118]	Rectum	Kidney
Hanlon[443]	Rectum	Kidney
Hanlon[443]	Rectum	Kidney
Hanlon[443]	Anus	Prostate
Jungshanns[523]	Rectum	Prostate
Muller[742]	Sigmoid	Prostate
Hanlon[443]	Rectum	Penis
Hanlon[443]	Sigmoid	Penis
Nehrkorn[752]	Anus	Bladder
Stalker, Phillips, Pemberton[952]	Sigmoid	Uterus
Kirshbaum, Shively[552]	Rectum	Kidney

TABLE 53. MISCELLANEOUS CASES

AUTHOR	SITE	SITE
Jungshanns[523]	Rectum	Esophagus
Bilello & Montanini[115]	Rectum	Esophagus
Carnevale-Ricci[197]	Rectum	Esophagus
Ophuls[770]	Rectum	Esophagus
Rau[853]	Rectum	Esophagus
Rau[853]	Rectum	Esophagus
Rau[853]	Rectum	Esophagus
Kaufmann[534]	Rectum	Orbit
Hanlon[443]	Sigmoid	Face
Klebs[553]	Rectum	Eyelid
Besche[108]	Rectum	Lip
Hanlon[443]	Rectum	Lip
de Vries[289]	Rectum	Tongue
Gottstein[417]	Rectum	Tongue
Hellendall[461]	Rectum	Breast
Eliot[316]	Sigmoid	Breast
Lockhart-Mummery[620]	Rectum	Breast
Norbury[761]	Rectum	Breast
Norbury[761]	Rectum	Breast
Kesteven[542]	Rectum	Breast
Lockhart-Mummery[626]	Anus	Breast
Eliot[316]	Rectum	Breast
Hanlon[443]	Rectum	Breast
Williams[1036]	Rectum	Breast
Seecof[922]	Rectum	Lung
Lockhart-Mummery[626]	Rectum	Bronchus
Muller[742]	Rectum	Bronchus
v. Volkmann[1012]	Rectum	Skin of buttocks
Warren & Gates[1025]	Rectum	Skin
Hibshman[471]	Rectum	Tongue
Stalker, Phillips, Pemberton[952]	Sigmoid	Both breasts
Kirshbaum, Shively[552]	Sigmoid	Tonsil
Kirshbaum, Shively[552]	Rectum	Hepatic
Kirshbaum, Shively[552]	Rectum	Gall bladder
Litchman[612]	Rectum	Lung

TABLE 54. SARCOMA AND CARCINOMA IN DIFFERENT SYSTEMS

AUTHOR	SITE	SITE	SITE
Warren & Gates[1025]	Adenocarcinoma, rectum	Lymphosarcoma, rectum	
Landau[588]	Carcinoma, rectum	Fibrosarcoma, breast	Osteoma, jaw
Werner[1039]	Adenocarcinoma, rectum	Fibromyosarcoma, uterus	

TABLE 50. THREE OR MORE MALIGNANT LESIONS—(*Continued*)

Author	Site	Site	Site	Site
Wulf[1066]	Rectum	Hepatic flexure	Splenic flexure	
Miller[726, 727]	Rectum	Hepatic flexure	Transverse colon	
Bunting[180]	Sigmoid	Cecum	Ileum	
Gotting[416]	Rectum	Stomach	Larynx	
v. Mielecki[711]	Rectum	Stomach	Larynx	
Jentzer[500]	Rectum	Stomach	Orbit	
Bargen & Rankin[85]	Sigmoid	Ascending colon	Splenic flexure	Uterus (sa.)
Lauds[596]	Rectum	Esophagus	Bile duct	Tonsil
Goetze[407]	Rectum	Stomach	Prostate	Colon
Bargen & Rankin[85]	Sigmoid	Cecum	Transverse colon	Splenic flexure
Klingenstein[536]	Sigmoid	Ascending colon	Transverse colon	Uterus
Schweiger & Bargen[921]	Sigmoid	Sigmoid	Sigmoid	
Litchman[612]	Rectum	Sigmoid	Cecum	
Whigham[1041]	Rectum	Cecum	Prostate	
Bargen, J. A.[82]	Sigmoid	Descending colon	Cecum	
Mayo, C. W.[682]	Rectosigmoid	Cecum	Descending colon	
Kretschmer[568]	Sigmoid	Bladder	Prostate	
Smith[942]	Sigmoid	Descending colon	Cecum	
Goldman[410]	Rectum	Uterus	Breast	Chest wall
Mider[710]	Rectum	Splenic flexure	Descending colon	
Mider[710]	Rectum	Descending colon	Splenic flexure	
Mider[710]	Rectum	Sigmoid	Sigmoid	

TABLE 51. DUAL MALIGNANCIES OF THE GASTRO-INTESTINAL TRACT

Author	Site	Site
Jungshanns[523]	Rectum	Colon
Kuster[576]	Rectum	Colon
Lockhart-Mummery[626]	Rectum	Colon
Lockhart-Mummery[626]	Rectum	Colon
Norbury[761]	Rectum	Colon
Warren & Gates[1025]	Rectum	Colon
Norbury[761]	Rectum	Transverse colon
Handford[437]	Rectum	Splenic flexure
Eliot[316]	Sigmoid	Splenic flexure
Bargen & Rankin[85]	Rectum	Cecum
Bargen & Rankin[85]	Sigmoid	Ascending colon
Abel[2]	Pelvic colon	Descending colon
Karsner & Clark[532]	Sigmoid	Descending colon
Behrend[94]	Rectum	Ascending colon
Lockhart-Mummery[626]	Rectum	Transverse colon
Littlewood[614]	Rectum	Splenic flexure
Littlewood[614]	Rectum	Ascending colon
Cokkins[232]	Pelvic sigmoid	Transverse colon
Cokkins[232]	Pelvic sigmoid	Descending colon
Cokkins[232]	Recto-sigmoid	Transverse colon
Goriainowa & Schabad[906]	Sigmoid	Stomach
Hauser[452]	Sigmoid	Stomach
Pemberton & Waugh[792]	Sigmoid	Stomach
Hauser[452]	Rectum	Stomach
Orr[774]	Rectum	Stomach
Rau[855]	Rectum	Stomach
Judd & Phillips[522]	Rectum	Stomach
Feilchenfeld[341]	Rectum	Stomach
Hanlon[443]	Rectum	Stomach
v. Hansemann[445]	Rectum	Stomach
Orr[774]	Rectum	Stomach
Lockhart-Mummery[626]	Rectum	Stomach
Kroger[569]	Rectum	Stomach
Devic & Gallovardin[285]	Rectum	Pylorus
Robson & Knaggs[874]	Rectum	Jejunum
Lockhart-Mummery[626]	Rectum	Pylorus
de Vries[289]	Rectum	Stomach
Deetz[275]	Rectum	Gallbladder
Brandt & Jekabson[153]	Rectum	Pancreas
Nicholls[758]	Rectum	Pancreas
Muller[742]	Rectum	Pancreas
Maingot[649]	Sigmoid	Stomach
Stalker, Phillips, Pemberton[932]	Sigmoid	Cecum
Kirshbaum, Shively[552]	Sigmoid	Stomach
Kirshbaum, Shively[552]	Sigmoid	Stomach
Schweiger & Bargen[921]	Rectum	Colon
Schweiger & Bargen[921]	Sigmoid	Ascending colon
Schweiger & Bargen[921]	Recto-sigmoid	Transverse colon

TABLE 55. PRIMARY MULTIPLE MALIGNANCY—(*Continued*)

No.	Name	Ref.	Age	Sex	Location	Location	Location	Treatment	Result
50	L. L.	U	65	F	Rectum	Bladder		R	Living and well 8 months following operation
51	I. A.	U	52	F	Rectum	Sigmoid		R	Living and well 7 months following operation
52	D. W.	U	73	F	Rectum	Sigmoid		R	Living and well 12 months following operation
53	A. C.	U	66	M	Rectum	Sigmoid		R	Living and well 12 months following operation
54	S. S	U	52	M	Rectum	Rectum		R	Living and well 11 months following operation
55	H. W.	U	58	M	Rectum	Sigmoid		R	Living and well 10 months following operation
56	W. V.	U	66	M	Rectum	Rectum		R	Living and well 12 months following operation
57	F. McG.	U	55	M	Rectum	Sigmoid cecum		R	Living and well 1 month following operation
58	T. S.	U	41	M	Rectum	Bladder		R	Living and well 3 months following operation
59	G. J.	U	43	F	Rectum	Sigmoid		R	Living and well 7 months following operation

* Unknown
R†—resection
EL—exploratory laparotomy
G—gastrostomy
C—colostomy
RA—roentgen therapy
U—unreported cases

In Table 55, cases 1 to 10 inclusive were isolated, and, as previously reported, a few were derived from Group C. Cases 11 to 59 inclusive, however, represent patients in Group A, namely, 800 of the author's series. Thus the incidence of the remaining 49 patients of primary multiple malignancy is computed at 6.1 per cent.

Attention is called to the fact that the vast majority of these patients are of relatively recent date. This may be explained *largely on the basis that, since we have* become more alerted to the possibility of multiple malignant lesions, additional efforts in sigmoidoscopy at higher levels, in radiologic studies, more careful palpation of the bowel at exploration and especially the removal of a more extended segment of gut have increased the incidence markedly. One must be mindful, too, of the role these lesions play in terms of recurrence, as has been noted by Norbury[760] and Berson.[100]

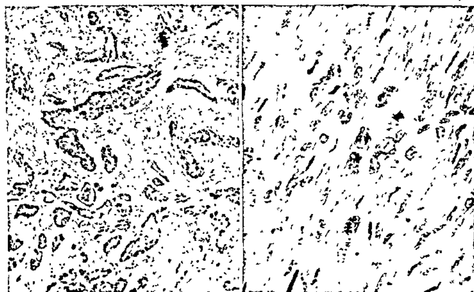


FIG. 441. Beneath the mucosa, and apparently springing from it in one area, is an adenocarcinomatous process invading the deeper layers. Primary adenocarcinoma of rectum. The fibromyomatous tissue in some regions is very cellular. The nuclei of these cells show considerable variation in size and in staining. Sarcomatous change in fibromyoma of uterus. Sections from a patient with carcinoma of the rectum and sarcoma of the uterus. (J. L. Werner.)

TABLE 54. SARCOMA AND CARCINOMA IN DIFFERENT SYSTEMS—(*Continued*)

AUTHOR	SITE	SITE	SITE
Nehrkorn[752]	Melanotic sarcoma, rectum	Carcinoma, uterus	
Dijkstra[292]	Spindle-cell sarcoma, rectum	Carcinoma, gallbladder	
Bargen & Rankin[83]	Adenocarcinoma, sigmoid	Sarcoma, uterus	
Cashman & Cohen[198]	Adenocarcinoma, rectum	Sarcoma cervix	
Schneider[1093]	Adenocarcinoma, rectum	Sarcoma cervix	

TABLE 55. PRIMARY MULTIPLE MALIGNANCY
(Author's Series)

No.	NAME	REF.	AGE	SEX	LOCATION	LOCATION	LOCATION	TREATMENT	RESULT
1	H. F.	50	53	M	Rectum	Rectum		R†	Known to have lived 4 years
2	T. S.	50	*83*	M	Rectum	Rectum		None	*Died; autopsy*
3	J. S.	50	*77*	M	*Rectum*	*Rectum*	*Sigmoid*	R	*Died following operation; autopsy*
4	G. S.	51	37	M	Rectum	Stomach		C	Died in 5 months
5	D. D.	51	41	M	Sigmoid	Stomach		EL	No follow-up
6	J. D.	50	61	M	Sigmoid	Lip		R	" "
7	J. R.	50	*72*	M	Sigmoid	Esophagus		G	*Died 12 days after operation; autopsy*
8	H. B.	50	79	M	Rectum	Nose		None	Died in 24 months
9	S. L.	50	80	M	Rectum	Tongue		C & RA	Known to have lived 3 years
10	S. Q.	50	50	M	Rectum	Gall-*bladder*		R	" " " " 9 "
11	R. F.	60	52	F	Rectum	Sigmoid		R	Living and well 29 months following operation
12	A. T.	60	67	M	Rectum	Tongue		R & RA	Lived 14 months
13	M. M.	60	69	F	Sigmoid	Breast		None	No follow-up
14	F. W. C	60	50	F	Rectum	Cervix		R	Died 12 days following operation
15	M. M.	60	38	F	Sigmoid	Cecum		R	Living and well 5 years and *2 months following* operation
16	W. J.	U*	35	M	Recto-sigmoid	Sigmoid		R	Living and well 3 years following operation
17	P. G.	U	41	F	Sigmoid	Uterus	*Bladder*	R	Living and well 1 year and 9 months following operation
18	G. G.	U	58	M	Rectum	Sigmoid		R	Living and well 2 years and 7 months following operation
19	W. G.	U	66		Rectum	Sigmoid		R	Living and well 19 months following operation
20	E. C.	*U*	56	*M*	Rectum	Sigmoid		*R*	Living and well *3* years and *1 month following* operation
21	A. L.	U	72	F	Rectum	Breast		None	Died in 4 months
22	H. K.	U	62	F	Rectum	Sigmoid		R	Living 10 months following operation
23	E. W.	U	56	M	Rectum	Sigmoid		R	Living and well 16 months following operation
24	E. A.	U	42	F	Rectum	Descending colon		R	Living and well 3 years and 6 months following *operation*
25	W. B.	U	32	M	Rectum	Sigmoid		R	Living and well 15 months following operation
26	M. K.	U	60	M	Rectum	Sigmoid		R	Living and well 11 months following operation
27	E. L.	U	52	F	Rectum	Uterus		R	Living and well 8 months following operation
28	P. S.	U	57	M	Rectum	Recto-sigmoid		R	Living and well 11 months following operation
29	B. F.	U	66	M	Rectum	Sigmoid		R	Living and well 10 months following operation
30	L. B.	U	52	M	Rectum	Rectum		R	Living and well 10 months following operation
31	*M. S.*	*U*	54	*M*	*Rectum*	*Rectum*		*R*	Living and *well 12 months following operation*
32	C. D.	U	29	M	Rectum	Rectum		R	Living and well 13 months following operation
33	*J. J.*	*U*	*60*	*M*	*Rectum*	*Rectum*		*R*	Living and well 13 months following operation
34	L. R.	U	49	F	Rectum	Ovary		R	Died 5 months following operation
35	M. K.	U	62	M	Rectum	Rectum		R	Living and well 16 months following operation
36	A. G	U	49	F	Rectum	Rectum		R	Living and well 15 months following operation
37	S. B.	U	59	M	Rectum	Rectum		R	Living and well 1 year and 8 months following operation
38	W. B.	U	24	M	Rectum	Sigmoid		R	6 months following operation
39	G. C.	U	65	F	Rectum	Sigmoid		R	Living and well 9 months following operation
40	J. F.	U	23	F	Rectum	Sigmoid		R	Living and well 8 months following operation
41	J. A.	U	66	M	Rectum	Sigmoid, descending colon		R	Living and well 8 months following operation
42	S. S.	U	*52*	M	*Rectum*	*Sigmoid*		R	Living and well 8 months following operation
43	F. F.	U	36	M	Rectum	Rectum		R	Living and well 8 months following operation
44	W. V.	U	66	M	Rectum	Rectum		R	Living and well 8 months following operation
45	L. S.	U	66	F	Rectum	Breast		R	Living and well 2 years following operation
46	L. I.	U	58	M	Rectum	Sigmoid		R	*Living and well 2 months* following operation
47	W. P.	U	53	M	*Rectum*	*Sigmoid*		*R*	*Living and well 3 months* following operation
48	D. W.	U	66	M	Rectum	Sigmoid		R	Living and well 1 month following operation
49	I. W.	U	63	M	Rectum	Rectum		R	Living and well 4 months following operation

FIG. 442. (*Top, left*) High-power magnification through Grade III carcinoma of rectum, showing infiltration of malignant cells with a typical acini. (*Top, right*) Photomicrograph of rectal carcinoma showing rather orderly arrangement of cells in acini with (in the lower right) beginning infiltration of malignant cells which has broken through the basement membrane. Grade I. (*Bottom, left*) Photomicrograph of rectal carcinoma, Grade IV, presenting malignant epithelial cells varying in size, shape and staining qualities. Mitotic figures are frequent and nucleoli large. The arrangement is typical. (*Bottom, right*) Section through a rectal carcinoma. Grade II showing a diffuse infiltration of rather adult epithelial cells with hyperchromatic nuclei.

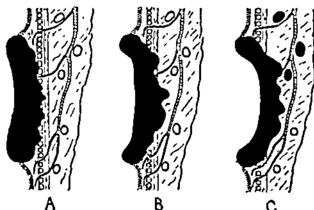
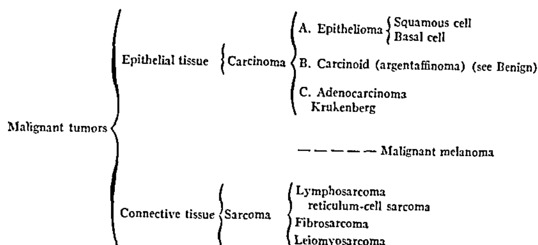


FIG. 443. (A) Growth limited to wall of rectum. (B) Extension of growth to extra-rectal tissues but no metastases in regional lymph nodes. (C) Metastases in regional lymph nodes. (Norbury, L. E. C.: Carcinoma of the Rectum, London, Lewis.)

CLASSIFICATION

Histopathology



Histologic Type of Tumor

In Group C, adenocarcinoma was shown to be by far the most frequent variety in this region, as noted in the following table:

	Number of Cases	Percentage	
Adenocarcinóma	946	83.4	90.9
Papillary carcinoma	32	3.0	
Villous carcinoma	32	3.0	
With myxomatous degeneration (Colloid cancer)	17	1.5	
Epithelioma—squamous cell	68	6.0	
Sarcoma	38	3.1	
	1,133	100.0	

In Group A, the histologic type of tumor is appended herewith:

	Number of Cases		Percentage
Adenocarcinoma	771		96.3
Epithelioma (a) Squamous cell	19	21	
(b) Basal cell	2		
Malignant melanoma	2	8	
Fibrosarcoma	3		
Leiomyosarcoma	2		
Neurogenic sarcoma	1		
	800		

Grading of Tumors. As early as 1893,[1013] attempts were made to grade malignant tumors by their histology. Stewart and Spies[960] employed as a basis the number of mitoses, the amount of papillary formation and the degree to which the polarity of the cells and their nuclei had been maintained. Others[1062] utilized low-power magnification, while MacCarty[614] used as criteria various changes in the stroma such as fibrosis, lymphocytic infiltration and hyalinization. Broders[158, 159, 844] classified malignancy on the basis of cell differentiation by microscopic grading of the neoplasm. He classifies them into four groups according to differentiation and mitosis. The more nearly the cell approaches the embryonic or undifferentiated type, the more malignant the tumor. Conversely, the more nearly normal the tumor, the less malignant it is. Those in which there is a high proportion (from 100 to 75 per cent) of differentiated cells are classified as Grade I (Fig. 442 top left); those in which the proportion is reduced to from 75 to 50 per cent are classified as Grade II (Fig. 442 top right); 50 to 25 per cent, Grade III (Fig. 442 bottom left); and 25 per cent or less, Grade IV (Fig. 442 bottom right). On this basis it has been shown that this histologic grading of tumors is of distinct prognostic value. Grades I and II offer relatively good results following surgical

Epithelial Tumors

Epithelioma. Epithelioma (skin cancer) is not uncommon in the anal region. The reported incidence is appended in the accompanying table:

Author	Total Series	No. Cases Epithelioma	Percentage
Buie and Brust[172]		51	1.7
Cattell & Williams[205]	600	10	1.7
Raiford[833]	352	10	2.8
Gabriel[380]	1700	55	3.3
Funke[372]			4.0
Kaplan[530]		8	4.6
Kerr[541]		80	5.0
Keyes[544]		40	5.7
Meland[704]	260	17	6.0
Quénu[828]			20.0
Sweet[978]	802	38	4.7
Bacon Group C	1133	68	6.0
Bacon Group A	800	21	2.6

Sex, Age and Race. Epidermoid carcinoma is about equally divided between males and females with a slight preponderance of the latter. In Keyes[544] series, however, 34 of 40 patients were females. From various sources the incidence of epidermoid cancer in the colored race reaches as high as 27 per cent.

The squamous-cell variety is the more frequent and originates in tissues lined by squamous epithelium, such as the anal canal and perineal region. That the presence of benign anal lesions may serve as a factor in the development of cancer has been promulgated, although it is our belief that such a condition is more often coincidental.

Pathology. It begins in the perianal or anal skin and presents itself as a slight thickening or small nodular elevation. It is firm, dry and has an indurated base. While at first movable, it later becomes fixed to the underlying tissues. (Fig. 445.) When well developed, the tumor breaks down to form an ulcer having raised, everted and rolled edges. The color is reddish-violet, while the base is necrotic and gray. The discharge is blood-stained, watery and irritating. There is a tendency toward crust formation and slight bleeding. Distinct nodules around the ulcer are usually present. Superficial extension occurs along the perineum, scrotum or vulva and to the inguinal lymphatics.

The basal-cell variety is rare. Only a



Fig. 445. Squamous-cell carcinoma of the anus. Case had been treated for pruritus ani.



Fig. 446. Large squamous-cell carcinoma of the anus.

treatment; whereas in Grades III and IV, the prognosis is increasingly poor.

The only criticism of this method of grading tumors is that different portions of the growth may vary histologically. This point has been discussed at length by



FIG. 444. Large squamous-cell carcinoma of the anus.

Dukes,[303] Dawson and Tod,[274] Reimann[861] and MacCarty.[643] Even though a high incidence of error has been reported by Norbury[760] (namely, 30 per cent), the variation in grade between the preoperative biopsy and the postoperative specimen is not a serious consequence, since both examinations are made routinely. In addition, differentiation is supported in most laboratories by the "mural penetration" method of Dukes. To a large degree, error may be avoided by the careful selection of the material for biopsy, removing a specimen from the base of the growth as well as its edge.

Lockhart-Mummery[628] adopted a method of classifying carcinoma of the rectum on a clinical as well as a pathologic basis. He employed three groups: (A) small movable lesions which did not appear to involve the muscular coat or the lymph nodes; (B) lesions which appeared to involve the muscular coat but were not fixed and the lymphatic involvement of which was not extensive, and (C) large growths which were fixed and in which there was evidence of extensive lymphatic involvement.

Dukes[301] modified this arrangement according to the pathologic findings in the postoperative bowel specimen and divided the spread of rectal cancer into Groups A, B and C, according to "mural penetration."

Group A represents those in which the growth is confined to the bowel wall and has not spread to the extrarectal tissues. Clinically it is usually polypoid, superficially ulcerated and movable with the bowel wall. Group B represents those in which the growth has spread by direct continuity into the perirectal or extrarectal tissues but the regional lymph nodes are not involved. Clinically the growth is fixed and markedly ulcerated. Group C represents those in which lymphatic metastasis has occurred. In other words, the regional lymph nodes are invaded. Clinically the growth is similar to B.

Further subdivisions of Group C have been made by Dukes, namely:

C1—those in which the lymph nodes are involved only in the vicinity of the primary lesion.

C2—those in which the lymph nodes are involved at a higher level, along the course of the superior hemorrhoidal vessels.

In concluding the remarks relative to grading of malignant tumors, it is established that for prognosis such classification is of definite value and further that a combination of Broder's method of "cell differentiation" and Duke's method of mural penetration yields a prognosis of survival more accurate than either method separately.

In our series of 800 cases (Group A), excluding the eight cases of sarcoma but including the 21 cases of epithelioma, the tumor was graded according to Broder's classification in 730 instances. The distribution is tabulated as follows:

GRADE	NO. CASES	PERCENTAGE
I	92	12.4
II	379	52.9
III	197	26.9
IV	62	7.8
Not graded	70	..
	800	100.0

blood stream. Local invasion of the sphincter musculature, perianal tissues, rectovaginal septum or prostate is not uncommon. Lymphatic metastasis occurs by way of the downward zone (sphincter muscle, most common, yet instances have been cited where metastasis has been noted 14[544] and 8[205] centimeters above the anus. Other incidences have been reported.[380, 400] This, of course, is explained on the basis of com-

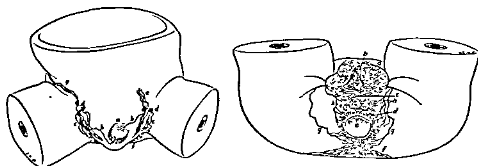


FIG. 448. (*Left*) Lymphatics of the skin of the shaft of the penis (anterior view) in the same specimen as that represented on left. Injection made in the skin of the shaft, using mercury. (a) Network of the skin of the shaft of the penis. (b, b) Collecting vessels from the network of the shaft. (c, c) Collecting vessels from the perianal network. (d, d) Inguinal nodes. (e) Beginning of the external iliac chain of the collecting vessels. (f) Network of the perianal skin. (g) Collecting vessels from the superior gluteal region. (*Right*) Perianal lymphatics and lymphatics of the external genitalia of a female, colored fetus at term viewed from below. The anus was dilated before fixation. Injections made in the skin overlying the lumbar, gluteal and sacrococcygeal regions, in the anal skin, in the skin of the fourchet and in the skin of the base of the right labium majus, using mercury. (a) Superficial lymphatic network of the labium majus. (b) Superficial network of the labium minus. (c) Superficial network of the fourchet. (d) Perianal network. (e) Anal network showing the origin of the vessels which ascend in the rectal columns of Morgagni. (f) Sacrococcygeal network. (g, g) Collecting vessels from the postanal plexus (sacrococcygeal). (h, h) Collecting trunks from the perianal and anal networks. (J. P. Nesselrod: Ann. Surg. 104:908.)

anal and perianal skin, ischiorectal fat), and the lateral zone (levator ani and coccygeus, pelvic peritoneum, prostate, base of urinary bladder, cervix and base of broad ligament). Both have been adequately described by Miles.[716] Although these lymphatic chains communicate above with the intramural group (see p. 647), the lymph is drained for the most part through the perineum into the inguinal nodes. This is shown in the accompanying illustration by Nesselrod.[753] It is best to realize that the zones of spread discussed above are the munication with the intramural chain. When this is considered together with the fact that epidermoid cancer metastasizes in approximately 70 per cent of all cases, most certainly one would be hesitant to recommend radiation therapy in preference to wide surgical extirpation.

Invasion to the inguinal nodes was noted in our series Group A in four instances. Metastasis to the liver has also been cited.[99, 123, 172, 541, 833]

Keyes[544] in his group of 40 cases has tabulated the incidence in 19 which are




FIG. 447. O. N., female, 52. (*Left*) Squamous-cell carcinoma, Grade III. Radiation therapy prior to resection. (*Right*) Same. Appearance following therapy. Case 4 in chart.

few cases have been reported.[172, 428, 597, 994] Ordinarily this variety of carcinoma begins as a small nodule in the dermis. It grows slowly and finally ulcerates onto the surface. In the two cases reported in our series, the ulcer was ragged, the base irregular and angry with the edges everted and somewhat rolled. Induration was conspicuously present. As may be surmised from the available reports, metastasis seldom occurs. On section, typical polygonal or spindle-shaped chromatic cells are arranged in isolated cords.

An entity of unusual interest is the occurrence of epidermoid carcinoma elsewhere than the squamous epithelium. For example, Keyes[544] cited a case of squamous-cell carcinoma in the descending colon, while Cattell and Williams[205] found a similar growth in the rectosigmoid. Conversely, Hosler and Murphy[485] reported two instances of adenocarcinoma involving the anal and perineal region. Still another rare case is that described by Thompson[989] in which the resected descending colon disclosed histologic evidence of both squamous-cell carcinoma and adenocarcinoma in the same tumor. While little is known regarding the cytogenesis and behavior of these growths, the most tenable hypothesis is that they arise from embryologic tissues which are misplaced during development. On the other hand, it has been explained on the theory that regenerative cells of the epithelium have the property to produce either a secretory (glandular) or protective (squamous) epithelium.[843]

METASTASIS. Metastasis from basal-cell carcinoma is practically nil, as determined from reliable sources. Our two cases presented no clinical evidence of such. While autopsy was not performed in either case, conclusions cannot be drawn on such a small group.

Squamous-cell carcinoma does metastasize, but less frequently and less widely than does adenocarcinoma. Locally it is more invasive but grows more slowly than adenocarcinoma. The mode of spread of this epidermoid growth is by continuity (infiltration), by contiguity, by the lymphatics (which is the most important) and by the

the ulcer is watery, bloody and irritating to the surrounding skin. Symptoms indicative of abscess and fistulae may occur as a result of the malignant process. Incontinence is frequently cited. Tender or painful mass in the groin may be mentioned, while late in the disease, loss of weight is described. Strangely enough the duration of symptoms with anal cancer is approximately six months more than with cancer of the rectum.

Diagnosis. The diagnosis of epithelioma of the anus is made on the presence of a nodular elevation of the anal lining which is pearly gray in appearance. The ulcer is fairly characteristic, although hypertonicity of the sphincter musculature may interfere with the interpretation. The base is angry in appearance and frequently covered by a dirty slough. The edges are nodular, rolled and usually everted. Hardness and fixation to the underlying tissues are, with nodularity, pathognomonic of a malignant growth. It is our custom to remove a specimen for examination in every case, not only to confirm our clinical diagnosis, but for gradation of the tumor. In anal lesions this may not be so simple, because of pain. The administration of an anesthetic such as sodium pentothal may be indicated under these circumstances.

Treatment. It was generally conceded that epitheliomata in this site would respond to treatment with radium because of their accessibility. Lockhart-Mummery, as a matter of fact, prefers irradiation to excision in such instances, and remarks, "The results of radium treatment are better than those obtained by operation." Pruitt reports good results in these squamous-cell carcinomata from inserting needles containing 1.33 mg. of radium into and around the growth, including the ischiorectal fossa. The needles are left in situ from four to six days, or until the dose of from 2,000 to 4,000 mg.-hours is given. In addition, external radiation is given over the sacrum, perineum and inguinal regions by the application of a plaque of columbia paste containing the needles. In this way approximately 9,000 mg.-hours are administered posteriorly and 7,000 mg.-hours anteriorly over each inguinal region. Souttar[948] employs a molded



Fig. 450. Case showing the destructive process resulting from an advanced squamous-cell carcinoma of the anus.

apparatus containing from 120 to 160 mg. of radium and applies it for from 15 to 18 days. The inguinal glands on each side receive a similar application. Binkley,[120, 131] however, advises external radiation of high-voltage roentgen rays and radium rays, to be followed by the interstitial implantation of gold-filtered emanation seeds. In some cases irradiation may be combined with surgery, as advocated by Yeomans. Here radon gold tubes of 0.3 mm. wall thickness are inserted into the tumor, followed by radical excision in from two to four weeks. Gordon-Watson[413] believes that if deep infiltration of the ischiorectal fossa or adjacent tissues or invasion of the inguinal gland has not occurred, an immediate cure may be anticipated with this method.

Binkley,[130] whose experience has been vast in treating anorectal malignancy, remarks that, besides being used as a palli-

Site	Squamous-Cell Carcinoma of Anus
Zone of Miles	
1. Downward (skin, fat, etc.)	12
2. Lateral (levators, etc.)	9
3. Upward (mesocolon)	0
Liver	0
Inguinal nodes	4
Lungs	1
Bone	0
	—
Total metastatic foci	26
Total patients	19

appended in the chart that is shown above.

The gradations of tumors in the 80 cases reported by Kerr[541] were as follows: 4 Grade I; 17 Grade II; 41 Grade III and 18 Grade IV. Gabriel[380] in a group of 55 cases found 22 low-grade, 21 medium-grade and 12 high-grade.

HISTOPATHOLOGY. Section shows solid columns of squamous epithelial cells growing down into dermis and known as epithelial pegs. The older central cells undergo degeneration and granules of eleidin appear in the cytoplasm. These cells form concentric masses which are irregular and characterized by groups of flattened cells arranged in concentric rings known as epithelial whirls which become converted into a mass of keratin indicating maturity. In the stroma are infiltrating inflammatory lymph and plasma cells. (Fig. 449.)

SYMPTOMS. Usually the patient gives a history of having a "lump" beside the anus that has been present for some time and which has progressively increased in size in spite of local remedies. Bleeding is a frequent symptom but seldom occurs until degeneration with ulceration of the growth takes place. Only in the incipient stage is pain absent. As infiltration occurs and the sphincter muscles are invaded, the pain is tormenting and at times even of an excruciating character. Tenesmus is not uncommon. Frequent desire for and incompleteness of evacuations, ribbon-shaped stools and fullness or pressure are usually cited by the patient. The discharge from

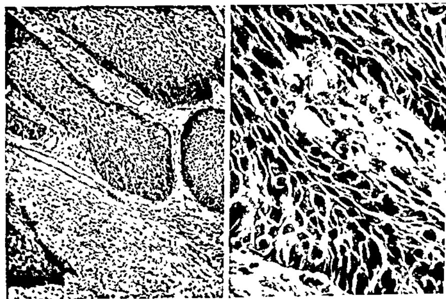


FIG. 449. (*Left*) Squamous-cell carcinoma of anus. Section through the corium showing elongation of the interpapillary pegs of malignant squamous cells. Basement membrane in the photograph is still intact. (*Right*) High-power magnification through illustration to left—showing malignant nature of the squamous cells.

ative means in inoperable cases, radiation therapy is capable of producing clinical cures in properly selected, favorable and operable cases. He suggests three distinct groups of cases in which radiation therapy may be employed advantageously:

A. Favorable and operable cases in which one may expect a clinical cure by this method alone. The tumor, however, must lend itself to interstitial radiation.[124] (Colostomy performed to relieve obstruction).

B. Operable cases in which preoperative radiation therapy offers advantages in promoting clinical cures.

C. Advanced cases in which radiation therapy, either alone or combined with colostomy, offers the highest degree of palliation.

Cattell and Williams[205] believe that surgical excision with radical inguinal dissection offers the best prognosis. Harvey[430] is of the opinion that for small growths two centimeters in diameter or less, radiotherapy may be justifiable in order to avoid radical removal. For large growths and those with metastasis, he recommends radical resection of the anus and rectum with removal of the inguinal nodes. Gabriel[350] prefers extended perineal excision, which view is shared by many.

A very practical approach to the management of epidermoid carcinoma is offered by Keyes.[544] *A summary of his opinion and* recommendations are as follows:

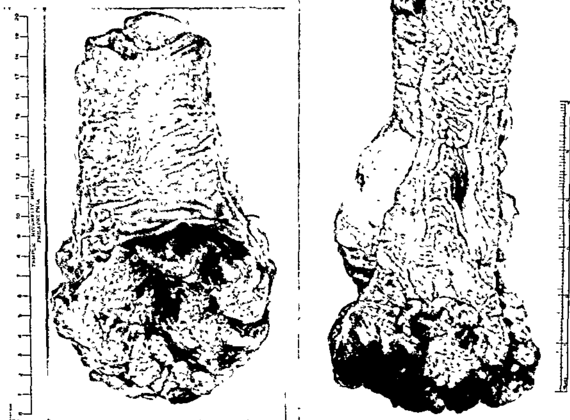


Fig. 451. (*Left*) Case 1. G. B., female, age 49. Squamous cell, Grade II. Specimen removed by colostomy and perineal excision. Infralevator glands involved. (*Right*) Case 6. A. L., male, age 67. Squamous-cell carcinoma, Grade III. Case 7. Colostomy and perineal excision.

TABLE 56. DIFFERENTIAL DIAGNOSIS

	Epithelioma	Condylomata Lata (Luetic)	Condylomata Acuminata	Chancroids	Verrucous Tuberculosis	Anal Esthiomene	External Thrombotic Hemorrhoids	Keloids
Characteristics	Usually occurs after 40; nodular growth; broad base, fixed to underlying structures; excess granulation; metastasis to inguinal nodes, which feel hard or stony but do not suppurate. Pain may or may not be present; at times is excruciating	Age 20-40; occurs as broad, flat papules covered with macerated epithelium; frequently assume a luxuriant fungating mass. Fissures and ulcerations common, at first red, then gray. Usually other evidence of syphilis on body of patient.198 Ordinarily no pain or irritation	Usually occurs as projections or tufts springing from a single elongated pedicle. No induration of base Glistening, pale pink in color. Single, multiple or conglomerate	Begin as a small macule, then papule; are multiple and warty, unilateral inguinal gland enlargement; suppurate freely. Very painful	Warty or papular excrescence; scalloped in outline; definitely circumscribed; brownish-red; mammillated; usually laterally placed; mothlike appearance; other evidence of T. B. Cause soreness and discomfort occasionally	Most common in Negro females between 18 and 30; granulomatous like mass frequently extending to vulva or scrotum, approaching at times very large proportions. Irregular, firm and dusky of color. Not tender unless ulcerated	Oval swelling, single or multiple; livid or blue; firm, tender and movable; painful	Usually in Negroes; represent an excessive formation of scar tissue; occur as firm, elevated patch. Recur after excision; painless
Ulceration	Crater-like, granular appearance with raised, irregular edges. Reddish-violet in color with gray base. Tendency to bleed. Scab formation. Discharge slight in amount and watery	Edges are sharply defined, rise at right angles to skin. Base is indurated and necrotic. Discharge effusive	Occasional discharge, offensive	Multiple ulcers, oval or circular with granular base and sharply defined edges; not elevated; soft; no induration; autoinoculable. Profuse discharge	Nodule breaks down to form round or oval ulcer, irregular in shape with sharply defined margins; soft, shallow base, spotted with yellow tubercles. Discharge is thick, yellow, scanty and foul-smelling	Sooner or later breaks down to form several areas of ulceration that are shallow, quite devoid and ugly in appearance and covered by a film of puruloid material. Discharge moderate in amount and purulent	Infrequent. If such occurs from irritation, the thrombosis is usually expelled. No discharge	Infrequent; no discharge
boratory	Biopsy positive	Wassermann always positive. Spirochete may be demonstrated in serum expressed from base of papules or from scrapings		B. Ducrey from scrapings or discharge. Ito-Reenstierna test positive	Demonstration of tubercle bacillus in scrapings and feces; tissue section shows typical histologic tubercles; test using P.P.D. positive	Histopathologic picture suggestive of Lymphopathia Venereum. (See Chapter 11.) Frei test positive		Overgrowth of connective tissue well differentiated

Subsequent periods have tempered this opinion materially. It is now our contention that each patient with epidermoid cancer *should receive careful individualized attention* and be given the benefit of both wide surgical extirpation and irradiation therapy. By many, the establishment of an abdominal colostomy has been recommended only *in the imminence or actual presence of* obstruction. Considering the local effects encountered following irradiation, it is our experience that an artificial abdominal stoma is often a real blessing to the patient.

Radiation therapy cannot be expected to destroy tumors deep in the perirectal nodes. Of course, inguinal metastases have not yet proven amenable to cure by either radiation or surgery. Prophylactic inguinal dissection, however, is recommended.

Our plan of approach for malignancy of *the epidermoid variety usually has* consisted of a preliminary double-barrelled or loop colostomy and perineal excision (Lockhart-Mummery technic). This latter step includes wide excision of the perianal *skin and ischiorectal fat and is best* performed with the surgical diathermy or Paquelin cautery. Radon seeds are introduced interstitially into the obturator and stumps of the anterior levator muscles. Except for a few approximating sutures, the perineal wound is left open to heal by granulation. From 10 to 14 days later bilateral inguinal dissection is instituted,

TABLE 57

(Author's Series)

No.	Name	Age	Sex	Symptoms	Histopathology	Grade	Treatment	Result
1	G. B.	49	F	Burning and itching	Squamous	2	C*; PE, RT	Still living 4½ years following operation
2	A. C.	71	F	Lump	Squamous	2	APR; RT	Died in 9 months
3	E. S.	56	M	Bleeding and soreness	Squamous	2	C; RT; PE; ID	*Still living 4 years and 8 months* following operation
4	O. N.	52	F	Bleeding and drainage	Squamous	3	RT; C; ID; PE	Died in 12 months
5	C. R.	43	M	Bleeding and pain	Squamous	3	C, RT, PE; R	Still living 3 years and 10 months following operation
6	A. L.	67	M	Bleeding and itching	Squamous	3	C; RT; PE	Known to have lived two years
7	C. H.	59	M	Painful lump, drainage	Squamous	4	Refused treatment	Not followed
8	H. A.	69	M	Bleeding, soreness and lump	Squamous	3	C	Died following operation
9	G. K.	64	F	Bleeding and pain	Squamous	4	APR; RT	Not followed
10	R. M.	60	M	Bleeding and lump	Basal	2	APR	Died 19 months following operation
11	B. B.	52	F	Burning pain, itching	Basal	2	RT; ID	Died in 9 months
12	S. L.	39	M	Bleeding and diarrhea	Squamous	2	APR	Died 10th day following operation
13	M. C.	43	F	Pain and bleeding	Squamous	2	APR	Living and well 13 months after operation
14	M. K.	38	F	Pain	Squamous	3	APR with excision of vagina	Living and well 14 months after operation
15	J. T.	38	F	Bleeding	Squamous	2	APR	Living and well 12 months after operation
16	L. L.	63	F	Pain	Squamous	3	APR	Living and well 10 months after operation
17	T. J.	49	M	Pain	Squamous	2	APR	Living and well 1 month after operation
18	A. A.	55	M	Pain	Squamous	3	APR	Living and well 6 months after operation
19	S. S.	65	F	Bleeding	Squamous	2	APR	Living and well 10 months after operation
20	S. F.	50	F	Pain	Squamous	2	APR	Living and well 9 months after operation
21	J. Y.	55	F	Pain	Squamous	3	APR	Living and well 4 months after operation

* Key:

C—Colostomy
PE—Perineal excision
APR—Abdominoperineal excision (Miles)
RT—Roentgen therapy
R—Radium
ID—Inguinal dissection

I Radiation	Squamous-Cell Carcinoma
Primary tumor in anus	If tumor is small, accessible
Primary tumor involving rectum	Not curable
Regional lymphatics & metastasis	Not curable

II Surgery	Squamous-Cell Carcinoma
Primary tumor in anus	If tumor is small or questionable
Primary tumor involving rectum	Curative and preferable
Ideal operation	Colostomy with perineal excision (Lockhart-Mummery)
Prophylactic inguinal dissection	Of debatable value
Inguinal dissection in the presence of metastasis	Not successful

III Palliative Irradiation	Squamous-Cell Carcinoma
Inoperable tumor	Valuable
Recurrent tumor	Valuable

An example of the results obtained by irradiation alone is shown in the appended chart by *Meland[704] in which 11 of 13* patients were treated with supervoltage roentgen therapy and radium:

Dead	2	2—7 years
Living	9	1—5 years
		1—4 years
		2—3 years
		1—1 year
		1—1 year
		1—less than 1 year

(*Meland mentioned that two patients* died before this report was published.)

A thirty per cent survival rate is shown by Gabriel:

Squamous-Cell Carcinoma of Anus on a Five-Year Basis

	No. Submitted to Radium Treatment or Excisional Surgery	*Five-Year Survivals*	*Percentage*
Low grade ..	15	6	40
Medium grade ..	11	2	20
High grade	4	1	
Total	30	9	30

Sweet,[978] in a recent review of 77 cases of epidermoid cancer, observed that 13, or 17.3 per cent, of the entire group survived the five-year period. In his series, radical surgery produced cures in 25 per cent, and, if *those untraced and those whose opera*tions were performed less than five years after inception are excluded, the percentage of five-year cure is 28.8. On the other hand, by irradiation, cure was effected in only 5.2 per cent.

On the basis of gradation of tumor, Kerr[541] found the following incidence of five-year survivals:

Grade	No. Patients Alive	No. Patients Dead
I	1	0
II	3	1
III	8	10
IV	2	9

Of 17 patients treated, Keyes reports that 7 lived 5 years or more, a survival rate of 41.2 per cent.

Cancer-Free Squamous-Cell Carcinoma of Anus

Surgery for Primary Tumor	
Surgery for primary tumor I.D.* ..	Cancer-free
Babcock operation	11 years
Perineal excision .	5 years
Perineal excision	9½ years
Perineal excision I.D.	6 years (died of pneumonia)
Lockhart-Mummery .	5½ years
Radiation for Primary Tumor	
Radon I.D. ...	10 years
Radium I.D.	5 years
Radium and x-rays	4 years
Radium	3½ years

* I.D. Inguinal dissection.

Reviewing the many reports at hand, the statistical surveys and recommendations made, a certain degree of confusion becomes manifest. It may be noted that while surgery alone is advocated, with radiotherapists suggesting irradiation, the best results are achieved where the therapy is combined, with close cooperation existing between the two departments.

The author was severely criticized for this suggestion, since just one decade ago[53, 54] *he advocated therapy by irradia*tion exclusively as the best chance of cure.

Subsequent periods have tempered this opinion materially. It is now our contention *that each patient with epidermoid cancer* should receive careful individualized attention and be given the benefit of both wide surgical extirpation and irradiation therapy. By many, the establishment of an abdominal colostomy has been recommended only in the imminence or actual presence of obstruction. Considering the local effects encountered following irradiation, it is our experience that an artificial abdominal stoma is often a real blessing to the patient.

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4	O. N	52	F	Bleeding and drainage	Squamous	3	RT, C; ID; PE	Died in 12 months
5	C. R.	41	M	Bleeding and pain	Squamous	3	C; RT; PE; R	Still living 3 years and 10 months following operation
6	A L.	67	M	Bleeding and itching	Squamous	3	C; RT, PE	Known to have lived two years
7	C. H.	59	M	Painful lump, drainage	Squamous	4	Refused treatment	Not followed
8	H A	69	M	Bleeding, soreness and lump	Squamous	3	C	Died following operation
9	G K	64	F	Bleeding and pain	Squamous	4	APR; RT	Not followed
10	R M	60	M	Bleeding and lump	Basal	2	APR	Died 19 months following operation
11	B. B	52	F	Burning pain, itching	Basal	2	RT; ID	Died in 9 months
12	S L.	39	M	Bleeding and diarrhea	Squamous	2	APR	Died 10th day following operation
13	M. C	43	F	*Pain and bleeding*	*Squamous*	2	APR	*Living and well 13 months after* operation
14	M. K.	38	F	Pain	Squamous	3	APR with excision of vagina	Living and well 14 months after operation
15	J T.	38	F	Bleeding	Squamous	2	APR	Living and well 12 months after operation
16	L. L.	65	F	Pain	Squamous	3	APR	Living and well 10 months after operation
17	T. J	49	M	Pain	Squamous	2	APR	Living and well 1 month after operation
18	A. A	55	M	Pain	Squamous	3	APR	Living and well 6 months after operation
19	S. S.	65	F	Bleeding	Squamous	2	APR	Living and well 10 months after operation
20	S. F.	50	F	Pain	Squamous	2	APR	Living and well 9 months after operation
21	J. Y.	55	F	*Pain*	*Squamous*	3	APR	Living and well 4 months after operation

* *Key*:

C—Colostomy
PE—Perineal excision
APR—Abdominoperineal excision (Miles)
RT—Roentgen therapy
R—Radium
ID—Inguinal dissection

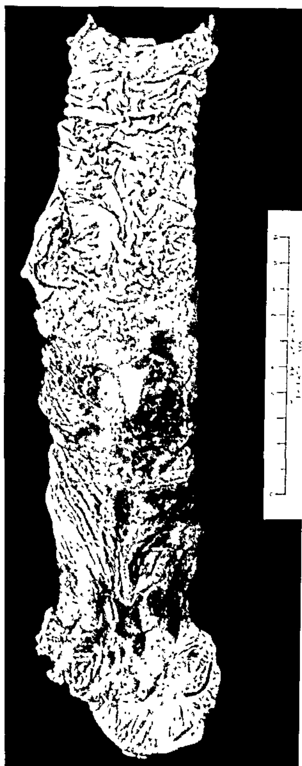


Fig. 452. Case 12. S. L., male, age 39. Squamous cell, Grade II, abdominoperineal excision (Miles).

including the femoral and iliac nodes as well as the surrounding fatty tissue. External radiation is administered thereafter. As a second choice of operative procedure, a one-stage abdominoperineal excision (Miles) is recommended. The author concurs with Cattell in the opinion that for epidermoid carcinoma, a permanent artificial stoma is essential. In fact, it may be said that colostomy is a necessary evil.

Author's Series. In Group C, it will be noted that there were 68 cases of squamous-cell carcinoma, an incidence of 6 per cent; in Group A, there were 21 instances. The form of therapy employed and results are shown in the table on page 637.

Carcinoma. Carcinoma is a tumor of unknown origin composed of glandular epithelium in atypical arrangement, variable in size, shape and consistency, with a tendency toward proliferation, metastasis and recurrence following removal. Carcinomata are essentially composed of irregular masses of epithelial cells and connective tissue stroma in varying amounts. They may become scirrhous or encephaloid, depending on the relative amount of epithelium and stroma of connective tissue present. The encephaloid or medullary type is soft, gray and made up largely of epithelium. It is usually of large size. The scirrhous type of carcinoma is hard, pale and tough and is composed mostly of fibrous tissue. It leads to contracture with subsequent stricture and is the most malignant.[44] Adenocarcinoma may show (a) inflammation, with or without infection; (b) degeneration such as myxomatous (mucoid); (c) necrosis, with or without hemorrhage; (d) ulceration. Colloid cancer, so called because of its shiny, glistening appearance, is in reality a myxomatous degeneration of the epithelial portion and in some cases the connective tissue stroma. (Fig. 454 left.) It is frequently designated mucoid, mucinous, or gelatinous carcinoma. The incidence has been reported as high as 5 per cent,[31a] although in Group C it is computed at 1.5 per cent. In another group previously reported by the author,[56] the incidence of colloid cancer was 3.5 per cent, although it should be stated that all of the 366 cases showed metastasis. Colloid carcinomas ordi-



FIG. 453. Case 13. M. C., female, age 43. Squamous cell, Grade II, abdominoperineal excision (Miles).

narily grow slowly and are late to metastasize,[780] although regional metastasis is extremely common and widespread.[767] The vast majority show a low grade of malignancy.[846]

Malignancy may develop in benign polypoid growths, either the adenoid or papillary type. A villous carcinoma may arise in a benign polyp or have an independent origin. (Fig. 454 right.)

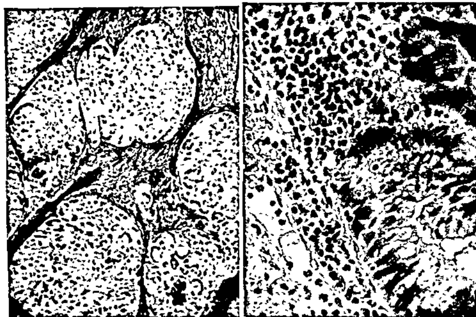


FIG. 454. (*Left*) Photomicrograph of section taken through colloid carcinoma of rectum showing large cystlike areas which have undergone mucinous degeneration. (*Right*) Photomicrograph (high-power magnification) of section taken through base of villous tumor showing the malignant nature of the epithelial cells.

Marino[961] reported a primary adenocarcinoma of the mucoid variety involving the ischiorectal fossa, and Scarborough[905] a primary *adenocarcinoma of the anal gland*



FIG. 455. Carcinoma of the rectum showing large crater-like ulcer. The rolled edges are well illustrated.

with metastasis to the liver and brain stem. Instances of benign adenoma of the apocrine sweat glands have been cited.[240, 804, 869]

Adenocarcinoma. Adenocarcinoma, also known as cylindric or columnar cell carcinoma, is the most frequent variety of cancer of the rectum. (Fig. 455.)

PATHOLOGY. Adenocarcinoma is derived from the columnar cells of the glands of Lieberkühn. It arises as a soft nodule or epithelial proliferation from the surface of the mucous membrane. As the cells rapidly multiply, the process extends peripherally on the surface by exuberant growth at its margin and by infiltration of the submucosa and deeper layers. The tumor at this stage is freely movable, but as penetration to the muscle coat occurs, the mass becomes fixed. The growth gradually increases in size and forms a large, fungating or cauliflowerlike mass. As a result, pressure necrosis which is dependent on the depth of penetration ensues, and the center breaks down to form a craterlike ulcer with a firm base, the edges of which are nodular and everted. The tissue is extremely friable and bleeds easily. Infection and continued irritation lead to further ulceration. As a result of progressive narrowing, obstruction may ensue and, while it is relatively uncommon in the rectum, especially the ampullary portion, it occurs quite frequently at the rectosigmoid junction and in the pelvic colon. In portions of the bowel characterized by a small lumen, such as the sigmoid, circumferential constriction occurs which is descriptively designated "napkin-ring deformity."

It will be noted that the mucosa immediately surrounding the tumor is thickened and indurated so that by this infiltration, which tends to follow the course of the blood vessels and lymphatics, the entire circumference of the rectum may become involved, forming an annular growth properly termed malignant stricture.

It is frequently mentioned that an adenocarcinoma may assume papillomatous or papilliferous characteristics, which, in the author's opinion, is a misstatement or an improper description of the true fact. Papilloma, which term refers only to form, usually begins as a benign process. Transformation to malignancy occurs often and as such represents the papillary type of adenocarcinoma. While this variety, by progression and proliferation, may readily assume the characteristic of sessility, it is extremely unusual for the sessile adenocarcinoma per se to develop papillomatous tendencies.

Adenoma Malignum. This term, as applied to neoplasms of the lower bowel, is used for papillary tumors in which the epithelial cells manifest an early change to the malignant type. Often only one segment, usually the distal portion, shows this change. Literally the term means a "malig-

nant benign tumor" and as such is meaningless, so that many pathologists believe it should be avoided. However, it has come to designate a definite entity, a papillary adenoma in transition to a papillary adenocarcinoma, and thus it provides a descriptive name to a common lesion of low-grade and early malignant character.

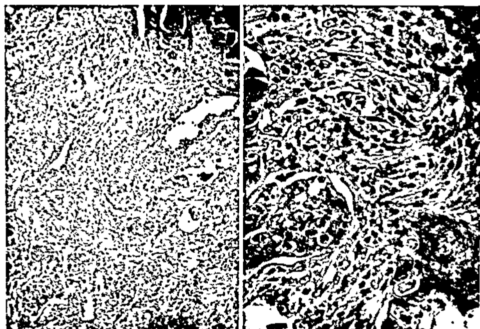


FIG. 456. (*Left*) Photomicrograph (low power) of section through an adenocarcinoma of the rectum showing pseudo acini surrounded by a stroma with inflammatory changes. (*Right*) Photomicrograph of rectal carcinoma showing malignant epithelial cells varying in size, shape and staining qualities. The lack of arrangement is characteristic. Mitotic figures are frequent and the nucleoli large.

HISTOPATHOLOGY. The tumor is derived from the columnar cells of the glands of Lieberkühn. The tumor shows numerous typical and atypical mitotic figures indicating rapidity of growth. Marked pleomorphism and variation in the number of nucleoli are seen. The glands are dilated and irregular in shape. The tunica propria harboring blood vessels and lymphatics is infiltrated. The muscularis mucosa is penetrated, the submucosa invaded, and the lymphatic network between the circular and longitudinal muscle layers involved. Finally the process extends through the longitudinal muscle fibers to the perirectal fascia. (Fig. 456.)

Krukenberg Tumor. In discussing pathology of the pelvic viscera, especially that dealing with malignancy, the ovary, per se, seems to be involved to a greater or lesser extent, and to be the site of metastatic extension. Two chief primary foci furnish the source of these secondary ovarian tumors:[293] (1) carcinoma originating intrapelvically (uterus, tubes, colonic divisions, etc.); and (2) carcinoma arising in the upper gastro-intestinal tract, gallbladder and pancreas. An additional source is the occasional case of mammary malignancy.

Inasmuch as ovarian involvement is very often due to direct contact or obvious lymphatic extension, Dockerty stated, in regard to the first source, that these secondary ovarian deposits invariably duplicate the

primary growth in microscopic appearance.

Although considered a rarity, occurrence of this tumor is of interest to proctologists in that it has been encountered in the rectum and sigmoid.[141, 242, 600, 621, 764, 1064] (Fig. 458.) Originally described by Krukenberg,[570] in 1896, as "fibrosarcoma ovarii mucocellulare carcinomatodes," it was thought to be a primary growth in the ovary, but various observers offered rather conclusive evidence that it originated elsewhere in the gastro-intestinal tract,[145, 152, 218] usually the stomach.[910] Krukenberg originally described the neoplasm as demonstrating on many occasions bilateral ovarian involvement by large, solid, lobulated growths, keeping within the normal contour of the ovary. The tumor possesses a distinctive microscopic structure, consisting chiefly of essential fibromyxomatous elements with a concomitant intermingling of "signet-ring" cells. The tumor growth was thought to be of sarcomatous origin, primary in the ovary. Schlagenhaufer,[910] together with other investigators, in subsequent investigations revealed that these characteristics were duplications of certain genera of metastatic ovarian cancers, especially those of gastric origin. The signet-ring phenomena was the source of a corrected diagnosis of carcinoma, rather than that of sarcoma. Other investigators believed in the existence of a metastatic extension. Ewing[229] rather pertinently stated that primary ovarian growth of the Krukenberg type did not exist. Dockerty[298] quoted certain examples like those reported by Andrews, Schiller and Kozoll, which were exceptions. These latter two investigators were inclined to think that certain malignant, mucinous, ovarian cystadenocarcinomata could, on occasion, very closely mimic the morphologic characteristics of metastasis similar to that found in the Krukenberg tumor.

Novak and Gray[764] stated that cases should be confined to neoplasms showing in their major portions the signet-ring formations, excluding those without glandular formations within a fibromyxomatous stroma. By this concept they created a limit of metastatic extension from anaplastic, mucus-producing, scirrhous, gastric carcinoma. Mammary, colonic and pancreatic carcinomata are infrequently of this type. These authors further state that the marked stromal reaction often seen in a minority of cases—sometimes even suggesting sarcomata — concomitantly with the paucity of epithelial elements, led Krukenberg into the error of designating these growths as of sarcomatous origin. They quoted Raiford as postulating that only 11.8 per cent of gastric carcinoma show the presence of mucoid material, the proportion for the small intestine being 14.3 per cent, colon, 30 per cent, and the rectum, 24 per cent. Of the 21 cases reported by the authors, there was but one in the sigmoid, a primary, nonmucoid adenocarcinoma. Two other cases in which the primary growth was located in the sigmoid have been reported,[929] although in our experience, as well as that of others, the rectal or sigmoid involvement appeared to be secondary to the stomach.[141, 621, 1064] Seven of a series of 44 cases reported by Lefiel and his co-workers[1064] were located in the rectosigmoid, and four in the colon. The authors observed one constant finding in the series —intracellular mucus in the epithelial elements. The so-called "signet-ring" cells, according to them, is not always encountered; on the other hand, while it is true that their predominance varies greatly, careful search always reveals some of them. These authors concluded that metastatic extension occurs in four ways: (1) by peritoneal sedimentation; (2) by the lymphatic channels, including retrograde spread; (3) extension by continuity, and (4) by the blood stream.

In discussing spread by sedimentation, it has been noted that (1) carcinomatous cells are frequently found in peritoneal fluids from cases of abdominal carcinomatosis;

(2) early involvement of the ovarian cortex without involvement of the medulla is occasionally seen. The last contention, however, is open to question. While ovarian involvement of the surface or cortex is occasionally encountered, medullary or hilar involvement is not. The authors had one such case. By what mechanism the germinal epithelium is permeated was unknown to them. They were of the opinion that primary adeno-"colloid" carcinoma of the ovary rarely mimics the Krukenberg tumor. Amann[17] believed that these tumors arise as a result of retrograde migration via the lymphatic channels, whereas Major,[651] after finding typical Krukenberg cells in the pulmonic blood vessels, concluded that the invasion was of hematogenous origin. Another theory is that of implantation.[134] The presence in certain cases of Krukenberg tumor of peritoneal carcinomatosis, with a concurrently high incidence of bilateral ovarian involvement, was taken by Copeland and Colvin[212] and other investigators as an indication that the carcinomatous cells reach the ovary via the peritoneal lymphatics. Other cases have been observed in which extensive involvement of the periaortic and pelvic lymph nodes suggested lymphatic extension to the ovaries by retrograde methods, according to Jarcho.[497] He stated that the number of complete autopsies on cases of this type had not been sufficient to demonstrate in all of them the "blockage" of higher chains of nodes, a phenomenon essential to occurrence of prior retrograde extension.



FIG. 457. Krukenberg tumor. (*Left*) Photomicrograph taken at junction of muscular coat and subserous connective tissue. Tumor can be seen diffusely infiltrating the muscular coat (below). Mucoid degeneration of fibrous tissue and characteristic signet-ring cells are well shown in the upper portion. (*Right*) Same view as illustration to left but higher power. (Bacon, H. E.: J.A.M.A. 103:1199.)

Clinically, symptomatology referable to the primary neoplasm is milder in type than those of the ovarian lesion in approximately 35 per cent of the cases.[298] Abdominal ascites is present in one third of all cases.[631] A cardinal point to remember is the possibility of bilateral solid tumors of a lobulated consistency, which may, in point of fact, be metastatic, and the problem of cure

in this type is materially different from the eradication of a primary growth. In these cases, cure may be effected in occasional instances by radical surgery followed by roentgen therapy.



Fig. 458. Krukenberg tumor of sigmoid. Shows a portion of sigmoid taken from area of stricture. Lumen of bowel can be seen running obliquely from upper left corner downward and to the right, with mucous membrane, submucosa, muscle, etc., on either side. The striking feature of this photograph is the marked thickening of the peritoneal coat, due to tumor infiltration. The white circle, midright side, indicates outer edge of muscular coat. Involvement of the muscle and submucosa can likewise be seen to the left of the circle. (Bacon, H. E.: J.A.M.A. 103:1199.)

Age Incidence. According to age, the 100-odd cases reported in the literature occurred mostly between 30 and 40, the youngest being 14[209] and the oldest 69.[631, 1018] As to sex, the author has found no reference to this condition in the male. So far as race is concerned, both white and colored have been affected. Only a few cases of rectal or sigmoidal involvement have been reported.[242, 366, 489, 497, 631, 892, 929, 1064] Two cases previously reported by the author[47] have been observed. In one the initial symptoms were referable to the sigmoid and rectum.

A woman, aged 25, was admitted to the University Hospital in November, 1930, because of nausea and vomiting. Four days later she was discharged. In June, 1931, she returned complaining of pain in the rectum and frequent stools. A diagnosis was made of rectal stricture, and a colostomy was performed. In December the patient was admitted to the Philadelphia General Hospital, at which time rectal examination elicited an irregular constricting mass about four inches above the anal margin. The patient succumbed three months later. Necropsy showed the intestine bound together and adherent to the pelvic organs. The left ovary was enlarged, firm and nodular. In the constriction of the sigmoid there seemed to be a generalized thickening of the serous coat. Lymph nodes of the mesentery and some of the retroperitoneal glands were enlarged but were soft and grayish pink. On the left side of the pelvic peritoneum were hundreds of small areas from 1 to 2 mm. in diameter in the suberosa. In the stomach was a diffuse infiltrating growth involving the subserosa, muscular and submucous coats, with great increase in the thickness of the wall, which resembled grossly a diffuse scirrhous carcinoma (linitis plastica). The other case

was that of a Negro woman, aged 41, who was referred to the proctologic clinic. She had an abscess three months before, which was lanced by her family physician and after which a discharge of pus was noted intermittently. On examination, an anorectal fistula was present. Digital examination elicited a circumscribed area one-half inch above the anorectal line and slightly to the left of the anterior rectal wall. The tract was excised after the internal opening had been located. The area that was thought to be inflammatory now appeared as a nodule the size of a small cherry, beneath the mucous membrane and located in the rectovaginal septum about three-fourths inch above the anorectal line. The nodule was smooth and firm. The histopathologic picture was that of a Krukenberg tumor. In checking the history, it was found that in December, 1932, the appendix, right tube and ovary had been removed. The latter was cystic. In April of the same year the patient had been operated on and a small growth found on the greater curvature of the stomach close to the pylorus. The laboratory reported carcinoma. This case is unusual. The diagnosis was initially made from the rectum.

Bose[144] reported a case of a 26-year-old Hindu woman, a nullipara. At operation, general peritoneal carcinomatosis and a large growth were found at the pylorus. Bilateral ovariectomy was done. Small growths were found in the rectal wall and bladder; very few adhesions were present. Microscopically, the tumor was a typical Krukenberg growth, with copious mucinous accumulation and in an advanced stage of degeneration. According to Fallas,[335] metastatic extension occurs early, and as each of the above reported cases bears out, is invariably fatal. The conception that these growths are sarcomata and not carcinomata has been previously reported. Factually, they are considered to be essentially carcinomatoid, containing fibrosarcomatoid elements,[468] even though some investigators are prone to look upon them as pure carcinoma.[320, 329, 566, 672] Histologically, they are characterized by round or oval vesicular cells of variable size. The nucleus is centrally placed or pushed to one side by the mucinous content so that it assumes a half-moon or crescentic form to which the appellation "signet-ring" has been applied. (Fig. 457.) Incidence of the entity seems to be increasing, according to many investigators and to the recently reported cases. As for treatment,[600] those who are essentially poor surgical risks or present extensive metastases should not be subjected to surgery save for relief of gastro-intestinal obstruction. Those deemed operable should undergo panhysterectomy with adjunctive roentgenotherapy.[218]

METASTASIS

Definition. This is understood to represent the formation of a secondary growth at a distance from the primary tumor and is one of the outstanding potentialities of most malignant tumors.

Mode of Spread of Rectal Neoplasm

The mechanism by which these cells reach or extend to new regions may be considered under the following headings: (a) direct continuity of structure (infiltration), (b) implantation or transplantation, (c) lymphatics and (d) blood stream.

A. Infiltration. For the purpose of clarity the term infiltration will be used reservedly to imply local invasion, peripherally and in depth. In both instances the process is gradual. The malignant cells by multiplication spread through the intercellular spaces or those by endothelium and invade the tunica propria, muscularis mucosa, submucosa and later the perirectal fascia. According to Miles, it is only after penetration of this perirectal fascia, which he terms "fascia propria," that invasion of neighboring structures such as the sacrum, uterus, vagina, prostate and bladder can take place.

In general, carcinoma of the rectum seems to enlarge equally in all directions superficially from a central point in the mucosa, although the lateral surface spread in the transverse axis progresses more rapidly than upward and downward in the longitudinal

axis. Miles[720] computed the period for complete annular involvement of the rectum to be from 18 to 24 months, which was confirmed by our investigators.[946] This corresponds to the conclusions of Glover and

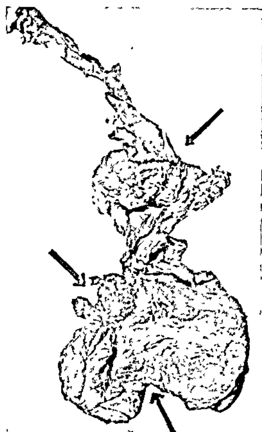


FIG. 459. Contact or "kiss" cancers. Unusual specimen showing three carcinomas. Lowest arrow points to malignant growth immediately above anorectal line; middle arrow to one in the lower midrectum and upper arrow to a third at the rectosigmoid. Serial sections of the bowel wall between the individual tumors disclosed no evidence of neoplastic growth. (H. E. Bacon: Am. J. Cancer, Feb., 1939.)

Waugh[405] that 6 months is the estimated time for carcinoma to travel approximately one quarter of the circumference. While the limits of the tumor within the submucosa are often slightly wider than in the mucosa itself, it is rare to find any extension in the rectal wall, especially below the margin of the surface growth, as our records disclose.

Staemmler and Fischer[353, 354] have shown that rectal carcinoma has a strikingly small tendency toward lateral spread in the wall layers and especially upward or downward. Westhues[1039] summarizes as follows: "It can be absolutely established that the bowel is healthy 1 to 1½ centimeters above and below a carcinoma." Previously Handley[440] cited a case of rectal carcinoma in which, by staining an entire section of bowel with mucicarmine, continuous spread was demonstrated in the submucosa beyond the gross limits of the tumor. However, Cheatle,[212] Cole,[235] Leitch[602] and Monsarrat[731] were unable to confirm this experiment and thereby concluded that this was an extreme rarity.

B. Implantation or Transplantation. It is recognized that implantation does occur, for many authentic cases have been reported.[112, 343, 479, 648] Here the cells become detached or are cast off and become implanted on another portion of the mucosa. This is not only observed in a hollow viscus such as the lower bowel but also in the peritoneal cavity. A subdivision would be the "contact" or "kiss" cancer, which term seems appropriately descriptive.

Not infrequently we have encountered a secondary growth engrafted by direct apposition or transfer of the cancer cells, especially in the narrowed portion of the lower rectum. It is obvious that variations in the histologic appearance would not be expected, inasmuch as they arise from the same type of epithelium. Where the arboral growth is the younger or where the two tumors are situated out of contact with each other or possibly when a prolonged period of time separates the appearance of the two neoplasms, they must be considered both primary neoplasms. (For discussion of primary multiple malignancy see page 617.)

C. Lymphatics. Dissemination by way of the lymphatics is the most conspicuous and therefore the most important phase. For the most part, the mode of spread conforms to an orderly pattern. While there

exists a tendency for carcinoma to remain localized and spread slowly, the frequency with which exceptions are encountered as evidenced by histopathologic study demands an intimate knowledge of this type of dissemination. Westhues has stated: "Actually up to 80 per cent of all cases of rectal carcinoma show local metastasis, so that rectal carcinoma is locally much more malignant than is generally assumed." Pathologically, two varieties of lymphatic metastasis are recognized, embolic and permeation. The former (embolic) is accepted as the most common. The cells, after invading the lymph vessels (also venous system), are carried to the regional lymph nodes or to some remote site causing secondary growths. The latter classification (permeation), refers to a continuous column of neoplastic cells along the endothelial lining of the lymph vessels from the primary tumor to the tributary glands. While acceptable as an explanation for small satellite nodules about carcinoma of the rectum, distant metastases on this basis are open to question, although Handley[438, 441] and Carnett,[104] *both vigorous proponents of the* theory of lymphatic permeation, offered objective evidence in its favor. In order to understand the mode of spread of this system, a description of the lymphatics is deemed expedient.

Anatomy. Our knowledge of the lymphatics of the anus, rectum and pelvic colon is based on the investigations of Gerota,[390] Quénu,[827] Bartels[86] and Scheuffer,[911] the injection studies of Delamere, Poirier and Cunéo,[278, 809, 810] Sappey,[900] and Rouvière[889] and, more recently, the contributions of Semba,[924] Most,[740] Paitre[777] and Villemin.[1003] In a commendable article on this subject, Nesselrod[753] has extended the work of Hadack and McMaster on the cutaneous and subcutaneous lymphatics in relation to proctologic as well as urologic problems.

For the purpose of clarity, the lymphatics of the rectum and anal canal may be divided into two main groups, a superior group and an inferior group.

A. *The superior group* is situated above the anorectal or dentate line, drains the

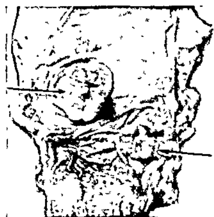


Fig. 460. Specimen of "kiss" cancer. (H. E. Bacon: Am. J. Cancer, 35:243.)

lymph from the rectum and finally terminates in the median lumbar glands. Under this heading is the intramural group, consisting of (1) a submucous network located in the submucosa of the rectum and (2) an intermuscular network, situated between *the circular and longitudinal muscle layers* of the rectum. Free communication exists between the submucous network and the intermuscular network, which drains into the intermediary group and then the extramural group.

While communication between the intramural group and a similar one in the pelvic colon has been described, investigators have shown that it is exceedingly sparse.[235, 723 731, 1039 1052] That an anastomosis does exist between the lymphatics of the rectum and those of the anal canal (inferior group) has been shown[730, 733 1039] The lymph of the intramural group drains into the channels of the intermediary group, consisting of (1) a subserous network located in that portion of the rectum which is covered by peritoneum and a network known as the "lymph sinus" lying outside the rectum (between the external muscle coat and the perirectal fascia but below the peritoneum).

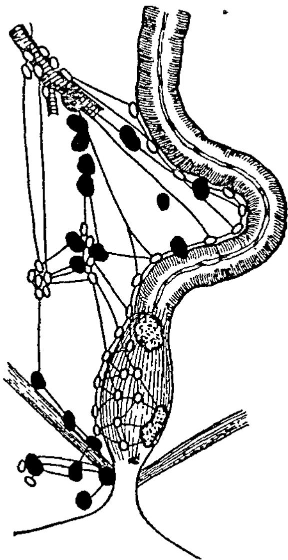


FIG. 461. Map showing the various positions in which metastatic deposits and postoperative recurrent growths have been found to occur. It will be seen that the ischiorectal fat, the levatores ani and the pelvic mesocolon (particularly the parietal border) are exceedingly dangerous tissues. (W. E. Miles: *Cancer of the Rectum, London,* Harrison.)

Thus, the lymph from the intramural group is drained by the lymph sinus, which, in turn, is collected by the extramural group. With the glands of Gerota, which are from four to seven in number, an extensive plexus scattered over the surface of the rectum is formed in relation to the branches of the superior hemorrhoidal vessels.

B. *The inferior group* is situated below the anorectal or dentate line which drains the lymph from this area and finally empties into the inguinal nodes. Occasionally the iliac and sacral nodes may be directly involved.

This lymphatic system consists of three main trunks, (1) the superior trunk, represented in the foregoing by A, arising from the entire length of the rectum proper to drain into the perirectal and mesocolic nodes; (2) the middle trunk, arising from the rectum at a point approximately above the insertion of the levator ani muscle to drain laterally between the levator and peritoneum into the hypogastric and sacral nodes along the middle hemorrhoidal and sacral vessels; and (3) the inferior trunk, represented by B, arising from a network about the external sphincter and a subcutaneous network beneath the anal and perineal skin to drain for the most part by way of the perineum and inner surface of the thigh into the inguinal nodes. It should be noted that these trunks correspond in general to the distribution of the superior, middle and inferior hemorrhoidal vessels and constitute the "three zones of spread" described by Miles[716, 723] as upward, lateral and downward.

Upward Zone of Spread. The "upward" efferents accompany the superior hemorrhoidal vessels, especially the veins, enter the retrorectal (sacral or lower mesocolic) glands located in the concavity of the sacrum, continue upward in the parietal border of the pelvic mesosigmoid to join the upper mesocolic glands situated at the bifurcation of the left common iliac and terminate in the median lumbar (aortic-composed of left and right lateral, preaortic and postaortic) nodes. This group also receives tributaries from the sigmoid.

Lateral Zone of Spread. This mode of dissemination embodies the lymphatics in relation to the levator ani, coccygeus and obturator muscles, the prostate, base of the bladder, cervix and base of the left broad

ligament to terminate in the internal iliac (hypogastric) nodes. Westhues has demonstrated rather circuitous routes according to the locations of the rectal growth: from the lateral wall of the midrectum to (a) glands about the hypogastric vessels and (b) to glands in the neighborhood of the inferior vesical vessels; from the anterior rectal wall in the male to the prostatic capsule, and in the female to the connective tissue between said rectal wall and the vagina upward to the adnexal glands above the recto-uterine hollow; from the posterior wall of the low rectum (a) along the middle sacral vessels and finally to the aortic glands, and (b) along the lateral sacral vessels to either the hypogastric (upper mesocolic) or aortic glands.

Downward Zone of Spread. These lymphatics accompany the inferior hemorrhoidal vessels and embrace such structures as the ischiorectal fat, perianal skin and external sphincter muscle to terminate in the internal iliac nodes.

COMMENT. From the aforementioned, inquiry may be made as to the importance of the lymphatic system and its correlation to pertinent phases in this type of dissemination which bear influence on such factors as prognosis and the type of resection.

It is common knowledge that adenocarcinoma is the most frequent variety of malignancy encountered in the rectum and sigmoid (over 90 per cent); further, that dissemination occurs most frequently by the lymphatic system and is usually embolic in character. Too, it is recognized that the spread of cancer is most commonly cephalad, conforming to the "upward zone" of Miles and in relation to the superior hemorrhoidal vessels, especially the veins.

The frequency of regional lymph node invasion may be ascertained by a perusal of Table 58.

CORRELATION OF METASTASIS TO SIZE OF GROWTH. Ordinarily the size of the carcinoma has little significance in determining the presence or absence of metastasis. While the older and larger growths tend to exhibit more local metastasis than do the younger or smaller carcinomas, very large lesions are frequently observed which are free of metastasis.

TABLE 58. INCIDENCE OF NODE METASTASIS IN RECTAL CANCER

AUTHOR	NO. SPECIMENS	METASTASIS PER CENT
Westhues[1039]	74	59
McVay[702]	100	47
Berger[101]	41	56
Gabriel, Dukes & Bussey[382]	100	62
Gilchrist & David[400]	47	68.1
Coller et al.[237]	53	64
Grinnell, 1939[424]	107	36
Grinnell, 1942[425]	75 (cleared)	55
Wood & Wilkie[1062]	100	51
Sugarbaker[972]	147	31
Seefeld & Bargen[923]	100	47
Kay[536]	53	64.2
Buday & Reichelman[170, 859]	1112	30
Bacon[46]	67	36 2

CORRELATION OF METASTASIS TO CIRCUMFERENTIAL INVOLVEMENT. Coller and his co-workers[237] have correlated the circumference of the wall involved with metastasis:

PERCENTAGE OF CIRCUMFERENCE INVOLVED	NO. CASES	WITH METASTASIS	PER CENT WITH METASTASIS
0- 25	4	2	50
25- 50	10	6	60
50- 75	22	14	63 6
75-100	17	12	70 6

Grinnell[425] found the incidence of node metastasis to be 53 per cent where the tumor was not completely annular and 71 per cent where it completely encircled the bowel. In our cases selected from Group A the incidence is shown as follows:

PERCENTAGE OF CIRCUMFERENCE	NO. CASES	WITH METASTASIS	PER CENT WITH METASTASIS
¼	14	4	28.5
½	25	11	44.4
¾	16	8	50
Entire	25	16	64

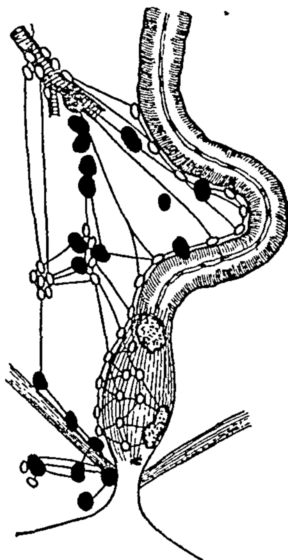


Fig. 461. Map showing the various positions in which metastatic deposits and postoperative recurrent growths have been found to occur. It will be seen that the ischiorectal fat, the levatores ani and the pelvic mesocolon (particularly the parietal border) are exceedingly dangerous tissues. (W. E. Miles: Cancer of the Rectum, London, Harrison.)

Thus, the lymph from the intramural group is drained by the lymph sinus, which, in turn, is collected by the extramural group. With the glands of Gerota, which are from four to seven in number, an extensive plexus scattered over the surface of the rectum is formed in relation to the branches of the superior hemorrhoidal vessels.

B. *The inferior group* is situated below the anorectal or dentate line which drains the lymph from this area and finally empties into the inguinal nodes. Occasionally the iliac and sacral nodes may be directly involved.

This lymphatic system consists of three main trunks, (1) the superior trunk, represented in the foregoing by A, arising from the entire length of the rectum proper to drain into the perirectal and mesocolic nodes; (2) the middle trunk, arising from the rectum at a point approximately above the insertion of the levator ani muscle to drain laterally between the levator and peritoneum into the hypogastric and sacral nodes along the middle hemorrhoidal and sacral vessels; and (3) the inferior trunk, represented by B, arising from a network about the external sphincter and a subcutaneous network beneath the anal and perineal skin to drain for the most part by way of the perineum and inner surface of the thigh into the inguinal nodes. It should be noted that these trunks correspond in general to the distribution of the superior, middle and inferior hemorrhoidal vessels and constitute the "three zones of spread" described by Miles[716, 723] as upward, lateral and downward.

Upward Zone of Spread. The "upward" efferents accompany the superior hemorrhoidal vessels, especially the veins, enter the retrorectal (sacral or lower mesocolic) glands located in the concavity of the sacrum, continue upward in the parietal border of the pelvic mesosigmoid to join the upper mesocolic glands situated at the bifurcation of the left common iliac and terminate in the median lumbar (aortic-composed of left and right lateral, preaortic and postaortic) nodes. This group also receives tributaries from the sigmoid.

Lateral Zone of Spread. This mode of dissemination embodies the lymphatics in relation to the levator ani, coccygeus and obturator muscles, the prostate, base of the bladder, cervix and base of the left broad

ligament to terminate in the internal iliac (hypogastric) nodes. Westhues has demonstrated rather circuitous routes according to the locations of the rectal growth: from the lateral wall of the midrectum to (a) glands about the hypogastric vessels and (b) to glands in the neighborhood of the inferior vesical vessels; from the anterior rectal wall in the male to the prostatic capsule, and in the female to the connective tissue between said rectal wall and the vagina upward to the adnexal glands above the recto-uterine hollow; from the posterior wall of the low rectum (a) along the middle sacral vessels and finally to the aortic glands, and (b) along the lateral sacral vessels to either the hypogastric (upper mesocolic) or aortic glands.

Downward Zone of Spread. These lymphatics accompany the inferior hemorrhoidal vessels and embrace such structures as the ischiorectal fat, perianal skin and external sphincter muscle to terminate in the internal iliac nodes.

COMMENT. From the aforementioned, inquiry may be made as to the importance of the lymphatic system and its correlation to pertinent phases in this type of dissemination which bear influence on such factors as prognosis and the type of resection.

It is common knowledge that adenocarcinoma is the most frequent variety of malignancy encountered in the rectum and sigmoid (over 90 per cent); further, that dissemination occurs most frequently by the lymphatic system and is usually embolic in character. Too, it is recognized that the spread of cancer is most commonly cephalad, conforming to the "upward zone" of Miles and in relation to the superior hemorrhoidal vessels, especially the veins.

The frequency of regional lymph node invasion may be ascertained by a perusal of Table 58.

CORRELATION OF METASTASIS TO SIZE OF GROWTH. Ordinarily the size of the carcinoma has little significance in determining the presence or absence of metastasis. While

TABLE 58. INCIDENCE OF NODE METASTASIS IN RECTAL CANCER

AUTHOR	NO. SPECIMENS	METASTASIS PER CENT
Westhues[1019]	74	59
McVay[702]	100	47
Berger[101]	41	56
Gabriel, Dukes & Bussey[382]	100	62
Gilchrist & David[400]	47	68.1
Coller *et al*[237]	53	64
Grinnell, 1939[424]	107	36
Grinnell, 1942[425]	75 (cleared)	55
Wood & Wilkie[1062]	100	51
Sugarbaker[972]	147	31
Seefeld & Bargen[923]	100	47
Kay[536]	53	64 2
Buday & Reichelman[170, 859]	1112	30
Bacon[46]	67	36.2

the older and larger growths tend to exhibit more local metastasis than do the younger or smaller carcinomas, very large lesions are frequently observed which are free of metastasis.

CORRELATION OF METASTASIS TO CIRCUMFERENTIAL INVOLVEMENT. Coller and his co-workers[237] have correlated the circumference of the wall involved with metastasis:

PERCENTAGE OF CIRCUMFERENCE INVOLVED	NO CASES	WITH METASTASIS	PER CENT WITH METASTASIS
0- 25	4	2	50
25- 50	10	6	60
50- 75	22	14	63 6
75-100	17	12	70.6

Grinnell[425] found the incidence of node metastasis to be 53 per cent where the tumor was not completely annular and 71 per cent where it completely encircled the bowel. In our cases selected from Group A the incidence is shown as follows:

PERCENTAGE OF CIRCUMFERENCE	NO. CASES	WITH METASTASIS	PER CENT WITH METASTASIS
¼	14	4	28.5
½	25	11	44.4
¾	16	8	50
Entire	25	16	64

CORRELATION OF METASTASIS TO DEGREE OF ULCERATION. Ordinarily the more deeply ulcerated the growth, the greater will be the extent of local spread in the perirectal tissues. This observation has been confirmed by various investigators, especially Dukes.

CORRELATION OF METASTASIS TO GROSS TYPES. It is generally recognized that sessile growths are more prone to metastasize than a malignant process protruding into the lumen.[304, 702] Such is clearly shown by the studies of Coller.[237]

Gross Type	No. Cases	With Metastasis	Per Cent with Metastasis
Excavating	3	1	33
Polypoid	28	15	53.5
Sessile	21	17	80.9

This closely parallels the observation of Gilbert and the author,[63] in 1938, that in a series of 318 cases of large bowel malignancy, all of which showed metastasis, the growth was described as sessile in 267, or 80.8 per cent.

CORRELATION OF METASTASIS TO LOCATION OF GROWTH. Some variation is observed in different segments of the lower bowel, as disclosed in the accompanying table:

Author	Location	No. Cases with Metastasis	Percentage
Mayo & Schlicke[685]	Sigmoid	77	62.2
Simpson & Mayo[937]	Sigmoid	51	29.4
Coller *et al*[237]	Sigmoid	4	66 6
Mayo & Schlicke[685]	Recto-sigmoid	41	70 7
Coller *et al*[237]	Recto-sigmoid	5	83.3
Mayo & Schlicke[685]	Rectum	83	55.4
Coller *et al.*[237]	Rectum	13	61.9
Coller *et al*[237]	Anal canal		57.9

In our cases selected from Group A the following incidence was found:

	No. Cases with Metastasis	Percentage
Sigmoid	9	60 0
Rectosigmoid	13	63.3
Rectum	24	44.1
Anal canal {squamous	5	57.1 } 50
Anal canal {basal	0	0 }

Comparing various segments of the rectum proper, Seefeld and Bargen[923] found the incidence of nodal involvement to be 48.8 per cent in the upper, 50 per cent in the middle and 40.2 per cent in the lower thirds. Above the peritoneal reflection, carcinomas arising on the mesocolic border of the bowel metastasize to the lymph nodes more frequently than do those in the vicinity of the antimesocolic border, as shown by Gilchrist and David.[400]

	Mesocolic Border	Antimesocolic Border	Circular
32 specimens with metastasis	17	12	3
15 specimens without metastasis	7	7	1

CORRELATION OF METASTASIS TO DEGREE OF CELLULAR DIFFERENTIATION BORDERS. Investigation has shown that it is unusual for carcinoma to invade the lymph glands until the tumor has penetrated the rectal wall, except where the growth is high-grade. The dictum that the more anoplastic the neoplasm, the higher the incidence of lymphatic metastasis, has been substantiated by the studies of Coller and others.

CORRELATION OF METASTASIS TO DEGREE OF MURAL PENETRATION (DUKES). That a definite relationship exists between lymph

INCIDENCE OF METASTASIS ACCORDING TO GRADE

Author	*I*	*%*	*II*	*%*	*III*	*%*	*IV*	*%*	*Mucoid*	*%*	*Total No. Cases*
Coller & Kay[237] .	0	0	19	57.5	13	72.2	1	100	.		52
Dukes[307]	16	24 2	23.1	41.3	159	71.0	13	92.8	80	65.3	985
Seefeld & Bargen[923]	3	21.4	20	37	18	75	6	75	..	..	100
Bacon (Group A)	1	9.1	16	45.7	7	70	3	100	..	..	59

nodes metastasis and the degree of mural penetration of the carcinoma is evidenced in the following chart:

Group A	15 per cent
Group B	35 per cent
Group C	50 per cent

The incidences of glandular involvement from rectal carcinoma to other portions of the colon is shown in the appended table by *Rankin and Graham:*

Rectum	46% showed nodal metastasis
Left Colon	31% showed nodal metastasis
Right Colon	34% showed nodal metastasis

INCIDENCE OF RETROGRADE NODAL METASTASIS. The subject of retrograde flow in carcinoma is of vital import, especially since there exists an altered or changing concept—a change of face attitude—concerning surgical management of lower bowel malignancy. During the past few years, isolated articles have appeared advocating methods which would eliminate colostomy, either by primary resection or *extirpation, with preservation of the sphincter* musculature. By the same token, an equally vigorous criticism from adherents to the principles laid down by Miles for rectal cancer and by Mikulicz for sigmoidal cancer has been advanced. In an effort to evaluate the problem impartially, and in order to arrive at some conclusion that may serve as a guide or index, the approach would seem to be based on the question: What is the import of retrograde nodal metastasis and with what frequency does retrograde nodal metastasis occur? Later in the chapter, pertinent points will be discussed, such as: What histopathologic evi*dence is available and from what source?*, What is the incidence of local recurrence? and What is the comparative survival rate in 5- and 10-year cures? Perhaps it would not be amiss to bring to date our knowledge of the subject and to employ direct quotation rather than literal interpretation.

As early as 1897, Waldeyer called attention to the facility by which epithelial cells spread in reverse direction to the lymph stream, while von Recklinghausen described a direct reversal of the lymph stream in a case of cancerous obstruction of the thoracic duct. Miles, in 1923,[716] contended that cancer extends in three directions, previously described as the "zones of spread," and *offered conclusive evidence, in support* of his operation "abdominoperineal excision,"[718, 722] to show that the incidence of recurrence could be greatly diminished by wide surgical extirpation, including that of contiguous gland-bearing tissues. His method was immediately accepted and since has been practiced successfully in all parts of the civilized world. However, Westhues of Erlangen published a noteworthy treatise in 1934, the original German or at least an accurate translation of which should be read by everyone interested in lower bowel malignancy. His sincerity of purpose is clearly portrayed in the following sentence: "From the huge mass of individual studies . . . every possibility of error must be excluded. When, for example I make the statement *on the basis of my studies, that rectal car*cinoma never metastasizes in the analward situated lymph nodes, one can see to what consequences an error in the study could lead." His investigations confirmed the work of Staemmler and Fischer[353, 354] that rectal carcinoma has a strikingly small tendency toward lateral spread in the bowel wall layers and especially downward. He continues, "Regional metastases lie only at the level of and above the carcinoma itself, practically exclusively in the *neighborhood* of the superior hemorrhoidal vessels and its branches . . . these local metastases are situated up to 12 centimeters above the car*cinoma . . . below the* carcinoma the perirectal and retrorectal tissue is always free of metastasis. Hence it is necessary in the radical operation to remove the peri- and retrorectal fatty and connective tissue at the level of the carcinoma itself and above this for 12 centimeters. Below the carcinoma, not only the bowel but also the corresponding connective tissue can be left without danger of recurrence." He further

TABLE 59. INCIDENCE OF RETROGRADE NODAL METASTASIS

	No. Specimens in Series Studied	No. Showing Cancer	Centimeter Distance Below Lesion
McVay[702]	100	1	1 cm.
Wood & Wilkie[1062]	100	0	0
Westhues[1039]	74	1	1 cm.
Gabriel, Dukes and Bussey[382]	100	2	1 cm.
Gilchrist[398]	74	6	4 cm.
Coller *et al.*[237]	53	1	1 cm.
Grinnell[425]	75	1	1 cm.
Colp[241]	18	1	3 cm.
		1	5 cm.
Glover & Waugh[405]	100	27	0-1 cm.
		6	1-2 cm.
		1	2-3 cm.
		1	3-4 cm.
		1	6-7 cm.
Bacon[1090]	146	2	2 cm.
		1	6 cm.

remarks: "It can be absolutely established that the bowel is healthy 1 to 1½ centimeters below the carcinoma, whereupon the resection line can be set unhesitantly 2 to 3 centimeters from the growth." Gabriel, Dukes and Bussey,[382] the following year, observed in their group of 100 specimens that the first glands to be affected are those in the immediate vicinity of the growths, after which a continuous spread takes place along the glands accompanying the superior hemorrhoidal vessels. They stated, "Lateral or downward lymphatic spread is only found in a late stage of the disease where the hemorrhoidal lymphatic vessels are blocked by metastasis." Gilchrist[398] also mentions that retrograde metastasis below the tumor may occur where there is gross enlargement of high-lying nodes with lymphatic blockage. He found retrograde metastasis of lymph nodes below the growth in six instances; in every case, however, the nodes central to the lesion were completely replaced by carcinoma showing marked obstruction to lymph flow and metastasis by retrograde means. Coller and his coworkers[237] comment thus: "*In no lesion of which the inferior border (of the growth) was three cm. or more above the mucocutaneous (pectinate or anorectal) junction did we find metastases along the lateral zone of spread.*" Grinnell,[425] in a series of 75 specimens, cites one case in which there was upward, lateral and downward spread in a growth located six cm. above the pectinate line.

Lymphatic spread downwards and laterally, according to Norbury,[760] occurs only with an advanced growth where the whole superior hemorrhoidal lymphatic path is blocked by metastasis. Quite recently Glover and Waugh[405] examined 100 postoperative specimens and demonstrated that even in far advanced carcinoma, retrograde spread along the course of the bowel occurs to any degree in only one per cent. With such rarity it may be justifiable to state that *retrograde metastasis never occurs from growths still in the stage of reasonable operability.* Section of the bowel must be at least two centimeters below the lower palpable edge of the lesion to satisfy pathologic requirements. In conclusion they remark, "When these facts become more generally appreciated and the technical procedures required for such surgery are subjected to refinement, many sufferers from neoplastic lesions will enjoy a normal postoperative existence without the psychologic—to say nothing of the anatomic—*detriments of a permanent artificial anus.*"

Consistent with these reports, it seems

TABLE 60. EXAMPLES OF RESECTION

No.	Initials	Age	Sex	Type	Grade: Broders	Grade: Dukes	Type of Resection	Cm. Bowel Removed	Circumference of Lesion	Section Below Growth		
										2 Cm.	4 Cm.	6 Cm.
1	E. McR.	63	M	Adenocarcinoma	II	C	AP.P.*	27	Entire	0	0	0
2	F. W.	62	F	Adenocarcinoma	II	C	AP.P.	25	¼	0	0	0
3	W. O.	52	M	Adenocarcinoma	II	C	AP.P.	31	Entire	+	+	+
4	G. S.	55	M	Adenocarcinoma	III	C	AP.P.	26	Entire	0	0	0
5	T. D.	55	M	Adenocarcinoma	III	C	AP.P.	25	Entire	0	0	0
6	P. C.	39	M	Adenocarcinoma	II	C	AP.P.	43	½	0	0	0
7	E. R.	42	F	Adenocarcinoma	II	C	AP.P.	19	¾	0	0	0
8	M. B.	66	M	Adenocarcinoma	II	C	AP.P.	22	Entire	0	0	0
9	S. L.	65	F	Adenocarcinoma	II	C	AP.P.	13	Entire	0	0	0
10	D. C.	36	F	Adenocarcinoma	II	C	AP.P.	24	Entire	0	0	0
11	P. G.	57	M	Adenocarcinoma	II	C	AP.P.	22	Entire	0	0	0
12	J. K.	58	M	Adenocarcinoma	III	C	AP.P.	31	Entire	0	0	0
13	S. A.	42	F	Adenocarcinoma	II	..	AP.P.	24	¼	0	0	0
14	J. P.	52	F	Adenocarcinoma	II		AP.P.	10	⅛	0	0	0
15	J. R.	60	F	Adenocarcinoma	II	C	AP.P.	31	Entire	0	0	0
16	F. A.	58	M	Adenocarcinoma	II	C	AP.P.	19	Entire	0	0	0
17	M. D.	49	M	Adenocarcinoma	III	C	AP.P.	22	⅛	0	0	0
18	E. H.	74	F	Adenocarcinoma	III	B	AP.P.	30	Entire	0	0	0
19	E. S.	64	M	Adenocarcinoma	IV	C	AP.P.	37	¾	0	0	0
20	E. V.	58	F	Adenocarcinoma	III	C	AP.P.	19	Entire	+	0	0
21	A. R.	72	F	Adenocarcinoma	II	C	AP.P.	28	¾	0	0	0
22	E. H.	57	M	Adenocarcinoma	II	B	AP.P.	29	¾	0	0	0
23	B W.	38	M	Adenocarcinoma	III	C	AP.P.	21	¾	0	0	0
24	L. W.	39	F	Adenocarcinoma	II	C	AP.P.	26	¼	0	0	0
25	H. K.	62	F	Adenocarcinoma	II	B	AP.P.	36	Entire	0	0	0
26	B. O.	40	F	Adenocarcinoma	II	C	AP.P.	24	Entire	0	0	0
27	C. T.	58	M	Adenocarcinoma	I		AP.P.	25	½	0	0	0
28	J. B	44	M	Adenocarcinoma	II	C	AP.P.	19	Entire	0	0	0
29	E. S.	72	M	Adenocarcinoma	II	C	AP.P.	21	Entire	0	0	0
30	R. B.	58	M	Adenocarcinoma	II	C	AP.P.	20	Entire	0	0	0
31	M P.	65	F	Adenocarcinoma	II	C	AP.P.	26	Entire	0	0	0
32	A. K.	57	F	Adenocarcinoma	II	C	AP.P.	21	¾	0	0	0
33	V. C.	60	M	Adenocarcinoma	II	C	AP.P.	19	¾	0	0	0
34	C. B.	68	M	Adenocarcinoma	II	C	AP.P.	21	Entire	0	0	0
35	S. B.	56	M	Adenocarcinoma	II	C	AP.P.	24	Entire	0	0	0
36	V. L.	56	M	Adenocarcinoma	II	B	AP.P.	16	Entire	0	0	0
37	G. G.	61	M	Adenocarcinoma	III	B	AP.P.	37	Entire	0	0	0
38	J. F	45	F	Adenocarcinoma	II	B	AP.P.	33	Entire	0	0	0
39	M. R.	59	F	Adenocarcinoma	II	C	AP.P.	20	½	0	0	0
40	A. V.	64	F	Adenocarcinoma	II	B	AP.P.	22	¾	0	0	0
41	P G.	41	F	Adenocarcinoma	III	C	AP.P.	14	Entire	0	0	0
42	G McF.	73	M	Adenocarcinoma	II	B	AP.P.	27	¾	0	0	0
43	L. K.	35	F	Adenocarcinoma	II	B	AP.P.	22	¾	0	0	0
44	W. G.	66	M	Adenocarcinoma	II	A	AP.P.	24	¾	0	0	0
45	J C.	55	M	Adenocarcinoma	II	B	AP.P.	28	Entire	0	0	0
46	W H	41	M	Adenocarcinoma	II	B	AP.P.	17	¾	0	0	0
47	A DeG.	68	M	Adenocarcinoma	II	B	AP.P.	40	Entire	0	0	0
48	A. K	55	M	Adenocarcinoma	III	C	AP.P.	22	¾	0	0	0
49	H. T.	32	F	Adenocarcinoma	II	B	AP.P.	28	Entire	0	0	0
50	H. T.	32	F	Adenocarcinoma	II	B	AP.P.	36	½	0	0	0
51	F. B.	47	F	Adenocarcinoma	I	C	AP.P.	32	¾	0	0	0
52	T. D.	56	M	Adenocarcinoma	III	C	AP.P.	26	Entire	0	0	0
53	L. M.	42	M	Adenocarcinoma	II	B	AP.P.	29	Entire	0	0	0
54	M. H.	62	F	Adenocarcinoma	N.G.†	B	AP.P.	27	¼	0	0	0

TABLE 60. EXAMPLES OF RESECTION—(*Continued*)

No.	Initials	Age	Sex	Type	Grade: Broders	Grade: Dukes	Type of Resection	Cm. Bowel Removed	Circumference of Lesion	Section Below Growth 2 Cm.	Section Below Growth 4 Cm.	Section Below Growth 6 Cm.
55	C. M.	49	M	Adenocarcinoma	III	B	AP.P.	41	½	0	0	0
56	N. M.	35	F	Adenocarcinoma	IV	C	AP.P.	35	Entire	0	0	0
57	J. D.	53	M	Adenocarcinoma	II	C	AP.P.	31	½	0	0	0
58	E. C.	59	F	Adenocarcinoma	II	B	AP.P.	32	½	0	0	0
59	C. R.	58	F	Adenocarcinoma	III	B	AP.P.	42	Entire	0	0	0
60	A. D.	76	F	Adenocarcinoma	II	C	AP.P.	30	½	0	0	0
61	B. C.	34	F	Adenocarcinoma	II	B	AP.P.	41	½	0	0	0
62	H. R.	53	M	Adenocarcinoma	II	B	AP.P.	32	Entire	0	0	0
63	M. M.	62	F	Adenocarcinoma	I	B	AP.P.	25	¼	0	0	0
64	A. D.	69	F	Adenocarcinoma	II	B	AP.P.	22	¼	0	0	0
65	J. A.	66	M	Adenocarcinoma	II		AP.P.		¼	..	..	..
66	E. C.	56	F	Adenocarcinoma	II	B	AP.P.	31	¾	0	0	0
67	S. S.	40	F	Adenocarcinoma	II	B	AP.P.	32	Entire	0	0	0
68	E. W.	56	M	Adenocarcinoma	II	B	AP.P.	42	¾	0	0	0
69	M. H.	62	F	Adenocarcinoma	II	B	AP.P.	39	¼	0	0	0
70	B. C.	53	F	Adenocarcinoma	II	B	AP.P.	28	Entire	0	0	0
71	T. O.	50	M	Adenocarcinoma	II	B	AP.P.	28	Entire	0	0	0
72	J. DeP.	60	M	Adenocarcinoma	II	B	AP.P.	54	Entire	0	0	0
73	W. J.	35	M	Adenocarcinoma	I	A	AP.P.	92	⅕	0	0	0
74	A. K.	70	F	Adenocarcinoma	II	B	AP.P.	26	½	0	0	0
75	K. C.	34	F	Adenocarcinoma	II	B	AP P.	28	Entire	0	0	0
76	C. W.	71	F	Adenocarcinoma	II	B	AP.P.	26	½	0	0	0
77	F. G.	38	F	Adenocarcinoma	II	B	AP.P.	28	½	0	0	0
78	N. G.	61	F	Adenocarcinoma	III	B	AP.P.	20	¼	0	0	0
79	M. T.	49	F	Adenocarcinoma	II	C	AP.P.	32	½	0	0	0
80	M. S.	37	F	Adenocarcinoma	II	C	AP.P.	38	¼	0	0	0
81	A. K.	58	F	Adenocarcinoma	II	A	AP.P.	26	¼	0	0	0
82	I. B.	54	M	Adenocarcinoma	I	A	AP.P.	42	⅕	0	0	0
83	P. D.	50	M	Adenocarcinoma	III	C	AP.P.	34	Entire	0	0	0
84	R. J.	55	F	Adenocarcinoma	II	B	AP.P.	28	Entire	0	0	0
85	E. C.	56	M	Adenocarcinoma	II	B	AP.P.	28	¾	0	0	0
86	S. G.	50	M	Adenocarcinoma	III	B	AP.P.	22	Entire	0	0	0
87	J. B.	63	M	Adenocarcinoma	III	C	AP.P.		Entire	0	0	0
88	M. S.	65	M	Adenocarcinoma	II	B	AP.P.	38		0	0	0
89	M. D.	41	M	Adenocarcinoma	II	B	AP.P.	33	¼	0	0	0
90	T. M.	54	M	Adenocarcinoma	I	A	AP.P.	26		0	0	0
91	P. S.	57	M	Adenocarcinoma	II	C	AP.P.	32	¾	0	0	0
92	E. W.	49	F	Adenocarcinoma	II	B	AP.P.	27	¾	0	0	0
93	M. K.	32	F	Adenocarcinoma	II	B	AP.P.	30	¾	0	0	0
94	A. L.	56	M	Adenocarcinoma	I	B	AP.P.	34	½	0	0	0
95	E. S.	59	M	Adenocarcinoma	II	A	AP.P.	23	½	0	0	0
96	C. S.	58	M	Adenocarcinoma	I	A	AP.P.	26	¼	0	0	0
97	W. B.	67	M	Adenocarcinoma	II	C	AP.P.	28	Entire	0	0	0
98	C. P.	64	F	Adenocarcinoma	III	B	AP.P.	24	Entire	0	0	0
99	C. M.	51	F	Adenocarcinoma	II	B	AP.P.	37	¾	0	0	0
100	J. H.	67	M	Adenocarcinoma	II	C	AP.P.	40	Entire	0	0	0
101	R. M.	60	F	Adenocarcinoma	II	C	AP.P.	34	Entire	0	0	0
102	C. T.	56	M	Adenocarcinoma	II	C	AP.P.	27	Entire	0	0	0
103	G. K.	62	M	Adenocarcinoma	II	C	AP.P.	21	¾	0	0	0
104	H. L.	55	M	Adenocarcinoma	II	B	AP.P.	41	¾	0	0	0
105	W. C.	32	M	Adenocarcinoma	I	A	AP.P.	68	¼	0	0	0
106	A. C.	63	F	Adenocarcinoma	II	C	AP.P.	22	Entire	0	0	0
107	J. T.	62	M	Adenocarcinoma	II		AP.P.	34	Entire	0	0	0
108	B. G.	35	F	Adenocarcinoma	III	C	AP.P.	49	½	0	0	0
109	H. A.	50	F	Adenocarcinoma	III	C	AP.P.	50	½	0	0	0
110	L. G.	59	M	Adenocarcinoma	II	B	AP.P.	36	½	0	0	0

TABLE 60. EXAMPLES OF RESECTION—(*Continued*)

No.	Initials	Age	Sex	Type	Grade: Broders	Grade: Dukes	Type of Resection	Cm. Bowel Removed	Circumference of Lesion	Section Below Growth 2 Cm.	4 Cm.	6 Cm.
111	E. A.	74	F	Adenocarcinoma	III	A	AP.P.	24	¾	0	0	0
112	G. M.	52	M	Adenocarcinoma	I	A	AP.P.	28	⅕	0	0	0
113	A. T.	42	F	Adenocarcinoma	IV	C	AP.P.	38	¾	0	0	0
114	J. S.	63	M	Adenocarcinoma	II	C	AP.P.	34	Entire	0	0	0
115	W. M.	65	M	Adenocarcinoma	II	B	AP.P.	26	½	0	0	0
116	W. M.	47	M	Adenocarcinoma	II	B	AP.P.	29	½	0	0	0
117	R. B.	49	M	Adenocarcinoma	I	A	AP.P.	..	¼	0	0	0
118	S. K.	58	M	Adenocarcinoma	II	B	AP.P.	36	Entire	0	0	0
119	R. D.	51	M	Adenocarcinoma	II	C	AP.P.	52	Entire	0	0	0
120	C. M.	78	F	Adenocarcinoma	I	A	AP.P.	22	¼	0	0	0
121	M. R.	59	F	Adenocarcinoma	II	B	AP.P.	27	½	0	0	0
122	J. C.	61	M	Adenocarcinoma	II	A	AP.P.	22	½	0	0	0
123	Q. G.	60	M	Adenocarcinoma	I	A	AP.P.	41	Entire	0	0	0
124	C. T.	58	M	Adenocarcinoma	II	A	AP.P.	27	½	0	0	0
125	I. S.	57	M	Adenocarcinoma	I	A	AP.P.		¼	0	0	0
126	L. W.	59	F	Adenocarcinoma	II	B	AP.P.	27	¾	0	0	0
127	E. V.	72	F	Adenocarcinoma	II	B	AP.P.	22	Entire	0	0	0
128	A. R.	58	F	Adenocarcinoma	II	C	AP.P.	24	Entire	0	0	0
129	E. A.	42	F	*Adenocarcinoma*	II	B	AP.P.	64	½	0	0	0
130	A. B.	63	F	Adenocarcinoma	II		AP.P.	29	¼	0	0	0
131	C. H.	36	M	Adenocarcinoma	II	B	AP.P.	26	¼	0	0	0
132	D. P.	68	M	Adenocarcinoma	II	B	AP.P.	30	Entire	0	0	0
133	N. H.	46	F	Adenocarcinoma	II	B	AP.P.	26	¾	0	0	0
134	G. B.	63	M	Adenocarcinoma	III	B	AP.P.	63	Entire	0	0	0
135	L. S.	66	F	Adenocarcinoma	II	B	AP.P.	27	¼	0	0	0
136	M. K.	59	M	Adenocarcinoma	II	B	AP.P.	36	Entire	0	0	0
137	J. O.	70	M	Adenocarcinoma	II	B	AP.P.	34	¾	0	0	0
138	J. A.	47	M	Adenocarcinoma	I	A	AP.P.	..	¼	0	0	0
139	?. W.	60	F	Adenocarcinoma	II	B	AP.P.	37	Entire	0	0	0
140	?. L.	52	F	Adenocarcinoma	III	C	AP.P.	31	Entire	0	0	0
141	M. B.	57	F	Adenocarcinoma	II	B	AP.P.	62	¾	0	0	0
142	E. C.	66	F	Adenocarcinoma	II	C	AP.P.	29	Entire	0	0	0
143	M. K.	58	M	Adenocarcinoma	II	B	AP.P.	34	¾	0	0	0
144	G. S.	54	M	Adenocarcinoma	II	B	AP.P.	34	Entire	0	0	0
145	A. G.	54	M	Adenocarcinoma	II	A	AP.P.	38	⅕	0	0	0
146	L. C.	57	F	Adenocarcinoma	II	A	AP.P.	36	¼	0	0	0

* AP.P.—Abdominoperineal proctosigmoidectomy.
† N G.—Not graded.

appropriate to mention our experience in a group of 146 patients in whom the removed specimen of bowel was sectioned serially at 2, 4 and 6 cm. below the lower edge of the growth. In all, an abdominoperineal proctosigmoidectomy without colostomy was performed. This operation was instituted only where the distance between the anal margin and the lower border of the growth was 6 cm. (3 cm. above anorectal line) or more. It will be noted that in Case 3, W. O., metastasis was present to a distance of 6 cm. below the growth. All superior lymphatics disclosed extensive lymph blockage. Case 20, C. V., showed invasion at 2 cm. distance below the growth. (See Table 60.)

It should be mentioned that the bowel is divided 7 cm. beyond the anal margin, so that this length may be added to each length of bowel removed. For example, in case No. 146, L. C., the length of bowel removed was 36 cm., which, with the 7 which is permitted to protrude and is later excised, would total 43 cm.

TABLE 61. INCIDENCE OF BLOOD VESSEL INVASION

AUTHOR	NO. CASES	VENOUS INVASION
Grinnell[425]	75	36 %
Dukes[307]	1000	17 %
Sugarbaker[972]	147	18 %
Seefeld & Bargen[923]	100	20 %
Brown & Warren[163]		61 % far advanced autopsy spec.
Berger[101]	47	29 %
Norbury[760]	..	18 %
Coller *et al.*[237]	53	15 %
Cattell[201]	.	15 %
Bacon (Group A)	67	12.9%

If it is permissible to draw conclusions relevant to the investigations aforementioned, the author's inclination would be to concur with Grinnell[425] in his statement, "It seems evident that downward lymphatic spread is of little importance except in advanced cases which are probably already inoperable because of extension along the main lymphatic route upward."

For a discussion of local recurrence and survival rates see pages 759 to 764.

D. Blood Stream. It may be well to reiterate that the superior hemorrhoidal vein, inferior mesenteric vein and portal vein, which empties into the liver, represent the portal circulation, whereas the middle and inferior hemorrhoidal veins which empty into the inferior vena cava represent the caval circulation. Although our knowledge of the vertebral vein system is extremely meager, a series of pathways is provided by which solitary malignant emboli may be deposited in remote parts. Such has been shown by the anatomic studies of Batson.[91, 92] Whether or not metastasis occurs to the vertebrae and skull, by-passing the caval system, is a subject for further investigation. It is generally conceded that but little parallelism exists between demonstrable blood vessel invasion and liver metastasis. While quite frequently liver involvement is disclosed at the time of exploration, and subsequent serial section of the postoperative bowel specimen shows no invasion of the veins, it does not necessarily follow that invasion was not present. Of course, it is possible for an embolus composed of cancer cells to reach the liver without leaving any trace of its movement.

It may be mentioned that Jones[510, 511] quite recently reported that he and Graham of the Cleveland Clinic observed venous invasion in 72 per cent of their cases. To the time of this writing, this data has not been published, although this percentage is far above that cited by others, as shown in the foregoing chart.

An interesting observation is reported by Dukes,[303] who, in a series of 63 postmortem examinations of patients dying within two weeks following operation, found malignant invasion of the hemorrhoidal veins in 20 and hepatic metastasis in 10.

According to Westhues, the lymph channels orient themselves almost exclusively according to the superior hemorrhoidal veins, suppressing those of the middle and inferior hemorrhoidal arteries to complete insignificance.

CORRELATION OF VENOUS METASTASIS TO CELLULAR DIFFERENTIATION AND MURAL PENETRATION. Conclusive evidence is available to show that the more active and rapid the growth, the greater the incidence of venous spread. Of several series reported, the vast majority of cases showing venous invasion fall into Grades III and IV of cellular differentiation and Group C of mural penetration.

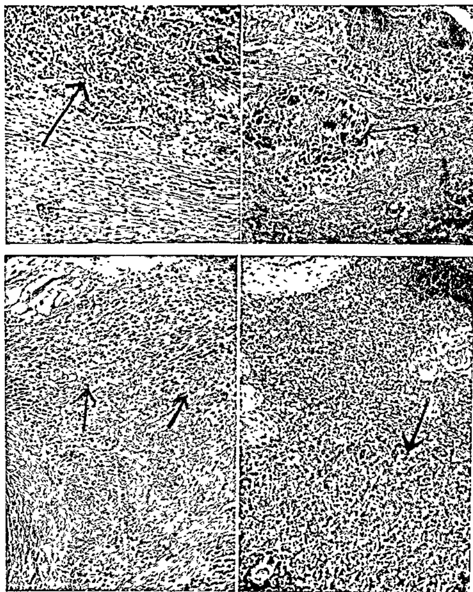


Fig. 462. (*Top left*) Low-power photomicrograph of section of heart muscle showing a large area of metastatic carcinoma. (*Top right*) Low-power photomicrograph of section of thyroid tissue showing metastatic adenocarcinoma invading the fibrous supportive tissue. (*Bottom left*) Low-power photomicrograph of section showing epithelial cells with malignant characteristics infiltrating breast tissue. (*Bottom right*) Low-power photomicrograph of section through spleen showing fairly well developed acini and pseudo acini of malignant epithelial cells invading normal splenic tissue.

Venous Invasion (Grinnell)

Grade I	*Per-cent*	*Grade II No. Cases*	*Per-cent*	*Grade III*	*Per-cent*
4 .	25	20	34	16	100
A	*Per-cent*	*B*	*Per-cent*	*C*	*Per-cent*
2 .	16	9	31	29	60

Kraske[505] and Iversen[494] noted metastasis in the following order of frequency: (1) liver, (2) peritoneum, (3) lungs, (4) brain. Mayo[630] and McArthur[692] observed that the liver is usually the first remote organ affected. Pruitt[820] estimated the fre-

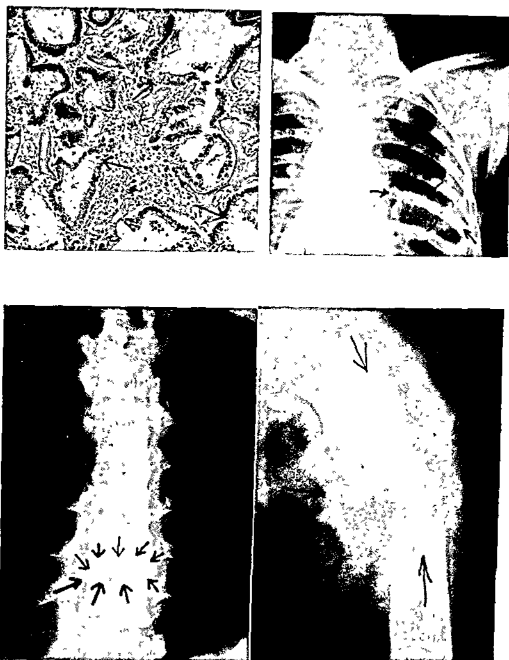


FIG. 463. (*Top left*) Low-power photomicrograph presenting spicules of bone and irregular acini lined with epithelial cells. Variety of adenocarcinoma fairly well differentiated. Right femur (115 magnification). (*Top right*) Metastatic carcinoma of rib from primary carcinoma of rectum. Postero-anterior roentgenogram of chest showing osteolytic destruction of posterior portion of seventh rib, right side approximately 7 cm. from costovertebral articulation. (*Bottom left*) Anteroposterior view of dorsal spine showing destruction of the body of the tenth thoracic vertebra due to metastasis from carcinoma of the rectum. (Arrows point to destructive process involving the spongy portion with collapse of the body of the vertebra. The intervertebral spaces are fairly well preserved.) (*Bottom right*) Metastatic carcinoma of femur from carcinoma of rectum. Note the marked rarefaction of the shaft with pathologic fracture in upper third of femur.



Fig. 464. C. O., age 40. Left clavicle shows a lesion in the medial third quite characteristic of metastatic carcinoma.

B-1 B-2 B-3

Fig. 465. Osteoclastic metastasis in humerus from carcinoma of rectum. Series of radiographs showing progressive rarefaction and destruction of shaft of upper one third of humerus with pathologic fracture and resultant soft-tissue invasion and swelling.



FIG. 466. Low-power photomicrograph of section through pancreas showing metastatic adenocarcinoma infiltrating the normal parenchyma.

quency of hepatic metastasis as 40 per cent, and while our percentage was almost parallel, it must be mentioned that this report[63] was based on 318 cases in Group D, all of which disclosed metastasis to one or more organs, as determined by biopsy, celiotomy, roentgenogram or necropsy. In our series of cases reported in 1944, the incidence of liver metastasis was 11.7 per cent.

Unusual Sites of Metastasis

A review of the literature reveals that metastasis from rectal carcinoma to obscure distant sites has been encountered, such as to the umbilicus,[1017] ureter,[831] eye,[84] humerus,[25, 1040] clavicle,[477] sternum,[1015] radius,[1015] ulna[146] and supraclavicular nodes.[422, 936, 982] It is interesting to note that Hubney and Mass,[488] in a review of over 1300 autopsies, found the greatest case incidence of skeletal and pulmonary metastases from cancer of the large bowel. Ghormley and Valls[395] reported 29 cases of metastasis to the spine, pelvis, ribs, sternum and scapula from a group of 51 metastatic growths in bone from the rectum and sigmoid. Bertin[107] cites 26 similar cases, while Aufses,[25] in a series of 117 cases, observed eight patients with bone involvement, or 6.8 per cent. In Group D (see p. 601), there were 15 instances of bone involvement, exclusive of the sacrum and coccyx, or an incidence of 4.4 per cent. If, however, the 40 cases of metastasis to the sacrum and coccyx are included in the incidence of the 366 cases, the incidence is 13.3 per cent.

The sites of metastasis and local extension from Group D, based on 318 cases, all

TABLE 62. SITES OF METASTASIS AND LOCAL EXTENSION IN 318 CASES
(Bacon and Gilbert[56, 63])

Site	Number of Patients	Percentage	Site	Number of Patients	Percentage
Liver	128	40.0	Diaphragm	3	0.9
Regional glands	99	31.1	Lumbar vertebra	3	0.9
Peritoneum	59	18.6	Dorsal vertebra	3	0.9
Lungs	47	14.7	Broad ligament	3	0.9
Bladder	27	8.5	Heart (epicardium)	2	0.6
Sacrum	22	6.9	Thyroid	2	0.6
Coccyx	18	5.7	Femur	2	0.6
Uterus	14	4.4	Ribs	2	0.6
Pancreas	11	3.5	Skull	2	0.6
Renal capsule	9	2.8	Buttocks	2	0.6
Prostate	8	2.5	Breast	1	0.3
Vagina	8	2.5	Duodenum	1	0.3
Spleen	7	2.2	Cervical vertebra	1	0.3
Inguinal glands	6	1.9	Shoulder girdle	1	0.3
Pelvis	5	1.6	Brain	1	0.3
Perineum	4	1.3	Testicle	1	0.3
Vulva	4	1.3	Mediastinum	1	0.3
Ovaries	4	1.3			

of which showed metastasis, are appended in Table 62.

The sites of distant metastasis, based on 366 cases also from Group D, all of which showed metastasis, are shown in the accompanying table:

SITES OF DISTANT METASTASIS IN 126 OF 366 CASES (BACON AND GILBERT[56, 63])

	CASES		CASES
Lungs	67	Heart	2
Bone (excluding sacrum and coccyx)	15	Thyroid	2
Pancreas	11	Breast	2
Renal capsule	10	Brain	2
Spleen	7	Duodenum	1
Adrenal	6	Mediastinum	1

CHAPTER 19—PART 2

SYMPTOMS

Cancer of the lower bowel does not cast its ominous shadow by any pathognomonic or characteristic symptoms. In general, the complaints referable to the rectum are vague and variable, depending in part on the duration, size and location of the tumor and the degenerative changes that have taken place. There are, however, certain symptoms and combinations of symptoms that should alert one to the presence of a neoplasm. A careful history is indispensable but should not be relied upon to the exclusion of a malignant process. The cure of cancer depends on radical surgical removal but such can be effected only by early diagnosis. It is unfortunate that patients, either through fear of disease or ignorance of its significance, fail to consult their physician for approximately one year from the onset of symptoms. To a lesser degree, there have been instances of individuals who have sought advice, but incomplete or inadequate studies failed to discover an existing malignant growth.

TABLE 63. DURATION OF SYMPTOMS (AVERAGE)

AUTHOR	NO. CASES	AVERAGE DURATION
Newman[757]	1,234	13.1 months
Brindley[156]	167	9.4 "
Cattell[201]	...	6 to 9 "
Seefeld & Bargen[923]	100	9.7 "
Rankin & Jones[654]	300	11.7 "
Swinton & Warren[950]	300	9 "
Braund & Binkley[154]	108	8 9 "
Kay[536]	53	8 plus "
Browne[165]	94	11 "
Silvers[935]	100	10 "
Besser[109]	348	11 "
Sugarbaker[972]	147	18 "
Bacon[63] (Group D)	1,031	9.7 "
Bacon[63] (Group A)	800	9.3 "

Growths in the sigmoid and at the rectosigmoid junction tend to encircle the circumference of the bowel, and, since the lumen is smaller and the fecal masses more formed, obstructive symptoms are prone to develop. Where the growth involves the anal canal, pain of varying intensity, usually severe, is the rule. Large papillary growths of the villous variety frequently secrete quantities of mucus that is quite viscid. Tumors attached to the anterior wall of the rectum are often associated with urinary dysfunction, or, if on the posterior wall, sacral pain may be cited. Pathologic changes occurring in the tumor mass, such as ulceration, may alter the symptomatology, which also may be said of associated phenomena such as hemorrhoids, fistula,

fissure, etc. Except for these brief remarks, the symptoms to be described serve to exemplify those usually complained of by the patient.

The first symptoms, noted accurately in 1,819 of the 1,995 patients, are as follows:

Group C:		
Bleeding .		574
Change in the bowel habit:		
Constipation . .	289	
Diarrhea .	269	
Frequent or urgent desire for stool	195	753
Pain:		
Discomfort	101	
Pain or tenesmus	391	492
		1,819

Passage of Blood. Bleeding is the most constant and one of the first symptoms. While it is fortunate that the passage of blood occasions alarm and causes the patient to seek medical advice, there is nothing characteristic about the amount of blood, its color or time of passage. With lesions of the rectum, the color of the blood is usually bright red, while in the lower colon it is more apt to be of a darker hue. Processes involving the upper intestinal canal and stomach give rise to a tarry color. Blood described as bright to dark red in color, sparse to profuse in amount and present on the stool, undergarment or in the toilet bowl was cited by 685 of our patients *from Group A, or 85.7 per cent. This is* slightly less than the incidence in Group C (87.2 per cent) or that reported by Buie[171] (87 per cent). Seventeen patients in Group A suffered one or more severe hemorrhages, and in three, previous hospitalization for transfusion of blood was found necessary.

Functional Disturbances. By "change in bowel habit" is meant an alteration of, or deviation from, the normal. It is a symptom-complex to be highly respected and one that warrants thorough investigation. Patients frequently complain of constipation and recall the increasing need for laxatives. This was cited in 430 of our patients, or 53.8 per cent. As a result of an attempt to promote normal bowel function by catharsis, a tendency toward diarrhea ensues, which was described by 252 of the patients, or 31.6 per cent. The fact that the constipation may alternate with the diarrhea, either alone or in combination, is clearly representative. The fact to be emphasized is that the evacuations are different than heretofore. A true diarrhea does not occur. Because of the induced inertia and the laxatives employed, a "frequent desire" or "exasperating attempt" for stool is complained of. The "false urge" to empty the bowel with the expulsion of "flatus" occurring from three to a dozen times daily is significant and was noted by 304 patients, or 37.8 per cent.

Symptom Referable to Bowel Habit	Cases	Percentage
Constipation—progressive	430	53.8
Diarrhea—frequent passage of stools	252	31.6
frequent desire for stools	304	37.8
in early morning .	136	17.1
Incompleteness of evacuation .	335	41.9
Ribbon- or pencil-shaped stools	39	4.9

Incompleteness of evacuation—the sensation that the movement is unsatisfactory—was mentioned by 335 or 41.9 per cent. The necessity for a patient to arise before the accustomed hour because of a desire for stool—"early morning diarrhea"—was de*scribed by Babcock*[31] years ago as a symptom seldom encountered other than in malignancy. It was complained of by 136 patients, or 17.1 per cent. Ribbon- or pencil-shaped stools are not uncommon in anal carcinoma and where the lesion is lying low circumferentially in the rectum, but are exceedingly infrequent where lesions are above these areas. Such a symptom was described by 39, or 4.9 per cent.

Sensory Disturbances. Pain is not an early symptom of rectal cancer. Usually it is the result of degeneration of the growth, such as ulceration or obstruction or invasion of adjacent organs and structures. Seefeld and Bargen[623] found a 30 per cent

incidence of endoneural and perineural invasion, where pain was complained of in approximately one third of their cases. While the terms "gnawing" and "boring" may be applied, patients usually identify the pain as an uneasiness or discomfort occurring in the rectum before, during, after or independent of defecation. Later a feeling of fullness and weight in the rectum develops which may be constant or intermittent. Still later it may be present as a dull ache, a sharp, stabbing pain or burning sensation confined to the rectum or the sacral region, or it may radiate down the limbs and shoot through the pelvis or to the lower abdomen. Disturbances referable to the bladder, urethra and prostate are not too uncommon and were mentioned by 57 patients, or 7.1 per cent.

Anal carcinoma or epithelioma is well known for the pain it produces, which is explainable by its innervation—namely, somatic or cerebrospinal. Increased straining and tenesmus are concomitant features. Of the 19 cases of squamous-cell carcinoma in Group A, pain was a factor in all. In addition, both leiomyosarcomas and one of the malignant melanomas caused pain.

Abdominal discomfort or distress tends to dominate the clinical picture where the malignant process is located in the sigmoid and at the rectosigmoid junction. Thus the patient becomes "abdomen conscious" by virtue of the disturbed physiology. Pain localized in the left lower quadrant or radiating across the lower abdomen and "cramp-like" or "colicky" in character is the usual story. Distention with rumbling and gurgling (borborygmus) is frequently cited, and sometimes some relief is experienced with or following evacuation of the bowel. Various types and degrees of pain occurred in 55 per cent of our cases, which nearly conforms to the incidence of 61 per cent reported by Rosser.

The discharges associated with malignancy of the lower bowel are usually described as blood and pus. Particles of fecal material, pus from degeneration of the growth, blood from ulceration and mucus as a result of the irritant are present. The condition may be altered materially by catharsis. The discharges possess a peculiar fetid odor, due to decomposing blood and malignant degeneration. Loss of weight is usually a late symptom; it is frequent in the presence of metastasis and where episodes of chronic obstruction with loss of protein, electrolytes and fluids have occurred. Cachexia, anemia and loss of strength are constant symptoms.

DIAGNOSIS

As stated by the late Daniel Fiske Jones,[507] "There is no disease that can be diagnosticated with more accuracy than cancer of the rectum," yet approximately 40 per cent of all patients with lower bowel malignancy are inoperable at the time of exploration. A perusal of the average duration of symptoms by various authors will disclose that a minimum of nine months exists between the onset of complaints and the time of operation. Delay by the patient, therefore, is an important factor, the correction of which can probably only be attained by education of the laity. Of equal import is the failure to search for the lesion. It is a grave sin of omission to neglect a proper examination when certain symptoms, or combinations of symptoms, should alert one to the possibility of a neoplasm. It is rather pathetic to realize that about 70 per cent of patients have been under treatment for colitis or hemorrhoids[507] and, according to Dixon,[293] at least 40 per cent had one or more hemorrhoidectomies before the correct diagnosis of cancer was made. Irrespective of the triviality of these symptoms, each patient should be thoroughly and completely investigated, and, if such a procedure is diligently practiced, the longevity of life and the survival rate following resection certainly will be materially increased. The method of examination entails the following:

1. Detailed history of the patient's illness
2. Inspection of the local parts
3. Digital examination of the rectum; vaginal in females
4. Adequate proctosigmoidoscopy
5. Opaque enema and roentgen study of the colon followed by air inflation. (Repetition if inconclusive)
6. Abdominal examination

Although no symptom or group of symptoms are considered pathognomonic of rectal cancer, a most painstaking history should be taken routinely. A history of "change in bowel habit" with bloody discharge should arouse suspicion in an individual, especially in or near the so-called "cancer age." He should be deemed potentially malignant until proven otherwise. There should be, however, no reluctance on the physician's part to make a diagnosis of cancer because of the patient's youth. A brief perusal of the age incidence is self-explanatory (p. 603).

Inspection is of the utmost importance, especially in the presence of the squamous-, or basal-cell type of malignancy. This has been described on page 629.

Digital Examination

After placing the patient in the left lateral or Sims' position with the knees well flexed on the abdomen, a well-lubricated gloved finger is inserted into the rectum, since a vast majority (77.5 per cent) of all malignancies are within reach of the examining finger. As the entire rectal wall is carefully palpated, the cancerous process is felt as a nodular mass easily distinguished from the surface of the mucous membrane and is firm to the touch and irregular in outline, with a base that is broad, indurated and fixed to the underlying tissues. Slight bleeding may be present even though ulceration be absent. In such cases it is due to

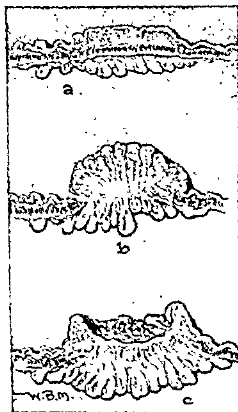
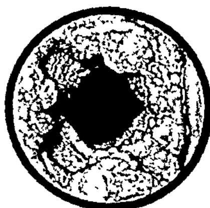


Fig. 467. (*Left*) Diagram showing the progressive surface changes in carcinoma of the rectum: (a) sessile elevation stage; (b) accentuation of (a) with nodular cauliflowerlike mass; (c) ulcerative stage, disclosing deep excavating ulcer. (*Below*) Proctoscopic view of a carcinoma involving the entire circumference of the rectum. Note the cauliflower appearance of the growth.



erosion of the mucous membrane. In the preulcerative stage of an adenocarcinoma, just described, difficulty arises in distinguishing this type from simple adenoma undergoing the initial stage of malignant degeneration. The latter lesion is usually found relatively soft, finely lobulated and slightly movable. In such, a biopsy should be taken, and, if determined benign, close supervision should be maintained and repeated biopsy procedures performed until the lesion is definitely declared to be nonmalignant. In our department it is customary to destroy the process by electrofulguration rather than wait for malignancy to develop. *Too, adenomatous polyps or* polypoid growths should be treated as potential sources of malignancy. While benignancy is usually manifested by the description already detailed (see p. 541, Chap. 18, Benign Tumors), here again early malignant invasion is more or less difficult to diagnose, and recourse should be made to tissue biopsy and should be repeated whenever necessary under supervision of the examiner. In the ulcerative stage, the center of the tumor has broken down, forming an ulcer well described as crater-like. Here the edges will be noted as elevated, everted and nodular and the base unduly hard. As the finger is withdrawn, it will be covered usually by mucopurulent material tinged with blood, probably best described as "brick-red dust." A mephitic odor accompanies the discharges. The malignant process may be localized in a small area of the wall or may encircle the lumen in its entirety. (Fig. 467.) The latter is referred to as an annular stricture and is felt as a hard, irregular stenosis of the rectum. For differentiating features see Table 64 below.

For tumors in the upper rectal ampulla or at the rectosigmoid junction, it is well to instruct the patient to strain down as if to *expel forcibly the finger, while the latter is* advanced as far as possible. Abdominorectal examination is of value in these high-lying cancerous growths and is accomplished with one finger in the rectum and one hand making firm pressure downward over the lower abdomen. In women a vaginal examination should *always be performed.* With one finger in the vagina and another in the rectum, the intervening wall can be carefully palpated. This is especially useful where the growth is attached to the anterior rectal wall. Not infrequently the squatting position may facilitate palpation of a high-

TABLE 64. DIFFERENTIAL DIAGNOSIS

	MALIGNANT STRICTURE	INFLAMMATORY STRICTURE
Age	40-60	20-40
Race	White	Colored
Sex	Male	Female
Palpation	Edges hard and nodular; base firm; induration marked; new growth; more prone to cause obstruction	Firm but not nodular; orifice of stricture feels like a circular ridge
Involvement	More on one side than the other; not uniform	Entire circumference involved uniformly; more often tubular in type
Odor	Fetid	Fetid
Ulceration	Begins in growth	More prone to occur late and as a result of irritation rather than "eating away"
Course and progress	Rapid	Slow
Glandular involvement	Always present	Infrequent
Loss of weight	Pronounced and rapid; cachexia early	Gradual; cachexia late
Laboratory: Biopsy	Positive for cancer	Characteristic of L. V. Negative Frei test usually positive



FIG. 468. Malignant stricture. Note the cauliflower appearance of the growth encircling the rectum.



FIG. 469. M. H., age 38. Malignancy of sigmoid resected with end-to-end anastomosis. Left ureter also resected. Patient had had resection of ascending colon for carcinoma three years previously. (H. E. Bacon and O. V. Gass: Am. J. Surg., 1945.)

lying growth. This is especially useful in the diagnosis of midsigmoidal growths prolapsing into the recto-uterine or rectovesical pouch.

PROCTOSIGMOIDOSCOPIC EXAMINATION

This is always indicated either where no pathology is found by digital examination or to verify that which the finger has elicited. No examination is complete without this procedure. Where the bowel is filled with feces, enemata should be administered until clean. This may necessitate more than one examination and perhaps several irrigations, but such are imperative. The sigmoidoscope is introduced (see p. 58) until the tumor is located, and its size, the degree of fixation and extent are noted.

Malignant growths may assume any shape, but are more often sessile than pedunculated. The proliferative mass appears cauliflower-like, irregular in outline and dusky red in color, which is in sharp contrast to the adjacent mucosa. The ulcer is single, deep and excavating in character. The base is angry and necrotic and the edges somewhat rolled and everted. It will be noted that malignant tissue is friable and is teased easily. It is from such a site that a specimen is taken for microscopic study to confirm the diagnosis and for gradation of the tumor. Where the lumen is partially occluded, a small-sized sigmoidoscope may be introduced, although great care should attend this procedure to avoid rupture of the bowel. In our series from Group A, the malignant growth was visualized sigmoidoscopically in 89.6 per cent of the cases.

ROENTGEN EXAMINATION

Roentgen study should follow and not precede sigmoidoscopy. It is indicated in every instance except in the presence of obstructive signs and symptoms. Carcinoma is readily demonstrated where the tumor produces deformity by significant encroachment upon the bowel lumen. On the other hand, such a lesion, when not bulky or constrictive, is usually poorly defined by roentgen examination. When the high incidence of secondary adenomatous or papillomatous growth is considered, a study of the rectum and colon is incomplete unless it includes



Fig. 470. (*Left*) Roentgenogram showing filling defect due to carcinoma. (*Right*) Carcinoma of the sigmoid showing marked filling defect.

opaque and double-contrast enemata. It is well to realize that lesions in the recto-sigmoid and rectum unless of large size are extremely difficult to visualize and may readily tax the ingenuity of the most expert roentgenologist. According to Oppenheimer,[771, 772] the filling is often so massive as to obscure small lesions or too scanty, after evacuation, to disclose sufficient detail. Reflux into the ileum tends to overshadow the rectosigmoid junction and, to





Fig. 471. (*Left*) Barium-enema study disclosing an organic stricture above rectosigmoid. Lumen of bowel is markedly narrowed for a distance of from three to four centimeters. (*Right*) W. N., age 43. Definite filling defect with canalization in lower sigmoid. Adenomacarcinoma, Grade II.

some degree, may be avoided by using a controlled "standard" coating. A procedure to be deplored is the administration of a barium meal (instead of barium enema) for the purpose of visualizing a suspected lesion in the lower bowel. While the character of the preparation for an opaque enema study is a moot point, there is no excuse for an examination without adequate cleansing.

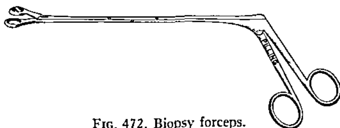


FIG. 472. Biopsy forceps.

Preparation. Ordinarily, one and one-half ounces of castor oil are given by mouth the night before examination. Neither supper nor breakfast the following morning is permitted.

Procedure. Two quarts of water, heated to body temperature and containing seven ounces of barium sulfate, are administered by the gravity method. The barium mixture is allowed to run in slowly through a metal tube inserted into the rectum for a distance of two inches, while the container is suspended two feet above the table. The patient assumes the supine position as the mixture passes into the rectum.

Under fluoroscopic control the progress of the barium column is carefully observed and checked by film. Based on the original investigations of Stewart and Illick[963] and the modifications of others,[367, 520, 873, 962, 1074] true lateral projection has supplemented the oblique position in examinations of the lower bowel. In brief, to supplement the anteroposterior view, a right antero-oblique film is made during the actual introduction of the barium. A true left lateral view of the sigmoid and rectum is deferred until after complete filling of the colon. For the best results the barium should be administered under fluoroscopic control. "Spot" or "flash" films are made during the introduction of the opaque material. Upon completion, air is inflated according to the double-contrast technic.[352, 392, 1030, 1031] For tumors of small size, especially, this contrast method is of utmost value.

BIOPSY, OR THE REMOVAL OF PORTIONS OF THE TUMOR MASS FOR MICROSCOPIC EXAMINATION

As is well known, the most accurate method for the diagnosis of malignancy is the microscopic examination of a portion of the tumor by an experienced pathologist. The value of biopsy is so well established that we advocate the procedure in every malignant or suspectedly malignant tumor of the rectum unless there is some particular contraindication or means of objective diagnosis and permanent record. In our department, a biopsy is taken in all cases as a routine procedure.

The word "biopsy" as used here denotes the histologic examination of material removed from a living subject.

Jones[505] was of the opinion that, in cases of doubtful malignancy, biopsy is always imperative and should be performed early. Falk[333] stated that, in the final analysis, diagnosis is definitely established by this procedure.

Disadvantages. The usual objections are that the removal of tissue stimulates the activity of the growth and causes dissemination of the malignant cells. Rosser[850] considers that this stimulus is minimal, and his view is supported by the investigations of Lubarsch,[632] which failed to show an





FIG. 473. (*Left*) E. K., age 66. Barium introduced into rectum outlines a large mass involving the rectum and causing a high degree of obstruction to the retrograde flow. (*Right*) W. M., age 65. Opaque enema disclosing a large filling defect in the rectum extending toward the rectosigmoid. Abdominoperineal proctosigmoidectomy performed.

increase in the growth of experimental tumors by means of trauma. Knox[557] remarks, "There is little evidence that a single trauma ever caused a malignant tumor to increase." Epstein and Fedorejeff[319] were of the opinion that complications or trauma following carefully performed biopsies are the exception rather than the rule. However, they did believe that increased rapidity of growth occurred with greater frequency in cases of sarcoma.

Ewing,[325] however, excluded melanomas, since this type of cancer is highly malignant. Although Wood[1061] observed that massage greatly increased metastasis, he found no increase following biopsy in his experiments on rat tumors.

McLean and Sugiura[690] stated that moderate or excessive aspiration biopsy procedure performed repeatedly on transplanted rat carcinoma and mouse sarcoma does not increase the percentage of distant metastasis. Nor does it produce any demonstrable damage to the tumor capsule or result in implantation of the tumor along the needle tract. In their experiments they did not report on regional metastasis, because they were forced to use transplanted tumor material. The original small implant may have some of its outer cells carried to regional nodes even before the residue which survives and "takes" forms its capsule and grows as a tumor. Double tumors and sometimes a series formed from a single implant are not uncommon, due to fragmentation of the original implant. Hanser[416] did not find metastatic increase following biopsy procedures and he is credited with the statement that the excision of tissue for this purpose will not produce cancer.

Perforation is very unusual and occurs only from carelessness. It should never occur when the procedure is performed under direct vision using proper illumination. Hemorrhage is seldom encountered.

Advantages. If the biopsy is positive, the histogenesis may be disclosed, its degree of malignancy observed and its radiosensitivity determined.

Procedure. Without anesthesia, an illu-

minated sigmoidoscope of suitable length is introduced under direct vision so as to expose the tumor mass. This is swabbed with cotton applicators to remove pus, blood and debris. A specimen of sufficient size is removed from a suspicious area of the growth or that considered most likely to show the malignant process. Necrotic tissue should not be selected. Where possible, a piece should be taken from the edges and base of the ulcer. The tissue is removed by means of a biopsy punch, the cautery loop or the endotherm loop. The last two are especially desirable since hemorrhage is negligible, thus rendering the operative field dry, the specimen is uncrushed and the lymphatics as well as the small blood vessels are sealed. Should bleeding occur using the ordinary forceps, it may be controlled by pressure, topical application of potassium permanganate (saturated solution), by actual cautery or coagulation. The specimens are placed in 10 per cent formalin and sent to the laboratory for interpretation.

Hoffman[482] described an improved biopsy punch named for him. The tissue obtained is examined by smear, by frozen section or following its embedding in paraffin. It is particularly valuable in the diagnosis of obscure tumors entirely lacking in pathognomonic features, for obtaining definite histologic delineation of the growths and for determining the results of irradiation. In a series of 100 biopsies done with the instrument there was no instance of fungation, infection or hemorrhage, and trauma appeared to be negligible. To assure certainty, however, the track of the punch may be coagulated.

Swan[976] recommends the preparation of frozen sections, since they are rapid, invariably accurate and, where immediate surgery is contemplated, save much needed time in confirming the diagnosis. Conversely, Ewing[221] opposed their use, stating that, while they are of occasional and decisive value, they tend to encourage hasty conclusions, thus readily leading to error. This author, in 1915, discussing the question of biopsy under the title "The Incision of Tumors for Diagnosis," arrived at the following conclusions:

(1) The careful excision of a small piece of malignant tumor by a sharp scalpel need not, as a rule, tend to disseminate or aggravate the disease. (2) Incision through the unbroken skin is seldom admissible for the sake of diagnosis, since it is the chief protective agent against infection, which, when once established in a tumor, greatly aggravates the disease. (3) The clinical history is an essential basis for the correct interpretation of microscopic structure, and failure to submit such data to the pathologist is responsible for much of the resultant confusion arising between surgeons and pathologists. (4) Tumor prognosis may, to a considerable extent, be based on this microscopic structure.

These conclusions are as applicable today as they were in 1915 when the late Doctor Ewing stated them.

Aspiration Biopsy. Martin and Ellis[695-696] employed this procedure in 1926 using an 18-gauge needle attached to a Record syringe and recommended its use in diagnosis of tumor masses lying below the surface. They were of the opinion that aspiration biopsy has few, if any, of the disadvantages suggested by critics of the method. For submucosal lesions and processes in the intravesical or extra-uterine pouch, we have found this method of utmost value.

Turkel Needles. TECHNIC. The needle is advanced and withdrawn when it has reached the tumor, care being taken to maintain suction on the syringe during these movements, because suction when the needle is not at rest is the invariable cause of failure to secure tissue. However, this suction must be released slowly, and the needle must be detached and withdrawn separately. The contents of the needle are expressed onto a clean glass slide by partially filling the syringe with air, attaching it to the needle and slowly pushing down on the piston. The material thus obtained is smeared on the slide and stained or is embedded in paraffin, sectioned and subsequently stained.





FIG. 473. (*Left*) E. K., age 66. Barium introduced into rectum outlines a large mass involving the rectum and causing a high degree of obstruction to the retrograde flow. (*Right*) W. M., age 65. Opaque enema disclosing a large filling defect in the rectum extending toward the rectosigmoid. Abdominoperineal proctosigmoidectomy performed.

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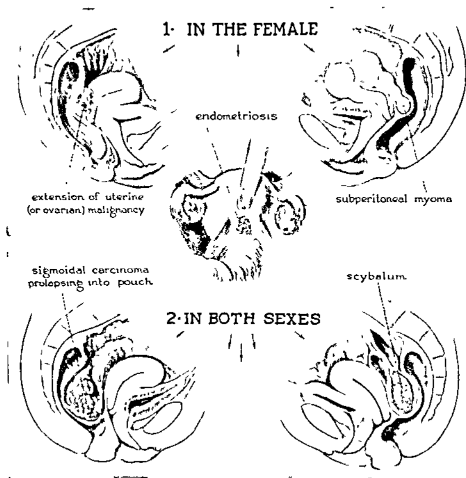


FIG. 474. Sagittal sections showing locations of malignant growths.

other chapters and, to avoid repetition, the reader is referred as follows: hyperplastic tuberculosis, Table 30, page 417; proctitis: syphilitic, amebic, bacillary, chronic-ulcerative, gonococcic, Table 13, page 282; gumma and tuberculoma, Table 31, page 419; inflammatory stricture, Table 25, page 383; adenoma, mucous prolapse, procidentia and villous tumor, Table 42, page 554; polyposis, Table 44, page 565; endometriosis, Table 45, page 574; diverticulitis, Table 17, page 330 and Table 18, page 330 (see Chap. 10, Diverticulitis, Tables 17 and 18); actinomycosis (see Chap. 15, p. 446); internal hemorrhoids, Table 36, page 472, Table 56, page 634.

One lesion that may be difficult to diagnose is a sigmoidal cancer that has prolapsed into the cul-de-sac and has become adherent or fixed. Digital examination usually elicits a hard and perhaps nodular growth anterior to the anterior rectal wall. Some degree of mobility may be present, and in the female bimanual examination may offer additional information. The patient should be placed in the inverted posture, and, in many instances, the anterior mass will have changed position or disappeared from the site. Sigmoidoscopy may disclose the lesion, whereas an opaque enema study will undoubtedly demonstrate the malignancy, as shown in Figure 474, 2, left.

Extrinsic. Not infrequently, processes of a physiologic, inflammatory or malignant nature occur pararectally and must be

David[267] is of the opinion that histologic examination by biopsy procedures offers some difficulties in diagnosis. Change in cellular morphology, mitotic figures in the cell nuclei, differences in staining properties of the nuclei—all these are seen in what clinically are benign tumors. When these are excised and examined histologically, their benignancy is confirmed. The most important histologic evidence indicating malignancy is the destructive invasion of epithelium through the basement membrane and muscularis mucosa of the bowel wall. This evidence is best obtained by securing the specimen from the base of the growth, which is difficult, at times, unless the entire lesion is extirpated.

Differential Diagnosis

Many diseases may simulate a malignant process, for which reason differentiation is essential.

Intrinsic. For the most part, the distinguishing features have been discussed in

Table 65. Differential Diagnosis

	Cancer	Sarcoma	Adenoma (Benign)	Gummata	Thrombosed, Ulcerated Internal Hemorrhoids
Origin	Glands of Lieberkuhn; mucosa	Submucosa	Mucosa	Submucosa	......
Age	40-60	30-50	Adult or youth	May occur at any age, but usually in middle life	20-50
Race	White	White	White	Colored	White
Sex	Male	Male	Female	Female	Male
History	Bleeding independent of stool; change in bowel habit; tenesmus; pain; mucous discharge; rapid loss of weight	Constipation or diarrhea; fullness in rectum; blood in stools; loss of weight more rapid	Constipation; bleeding; protrusion if polypoid	Lues; incomplete evacuation	Protrusion and bleeding at time of or following stool; blood bright red in color
Characteristics	Single, irregular nodular mass; firm, broad base; indurated and fixed; edges of ulcer raised, rolled and nodular; odor fetid. Tends to recur	Circumscribed, single or multiple; rapidly increases in size; may be pigmented. Tends to recur	Soft and elastic to touch; attached to normal mucous membrane wall by its broad base; or by pedicle, in case of polyp	Single or multiple; hard ovoid or egg-shaped swelling; painless	Globular swelling, somewhat softer; usually multiple in quadrants of the rectal circumference; firm but movable; smooth and glistening except over ulcerated area which is superficial. Always occur within 1 inch above anorectal line
Ulceration	Early and usual	Usual	Not infrequent	Frequent	Occasional
Fixation	Fixed	Fixed	Movable	Movable	Movable
Metastasis	Usually by lymphatics	Earlier usually by blood stream	No	No	No
Laboratory	Biopsy positive for carcinoma	Biopsy positive for sarcoma		Blood Wassermann positive	

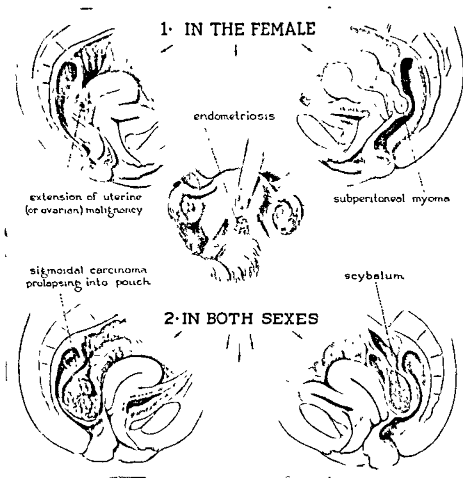


FIG. 474. Sagittal sections showing locations of malignant growths.

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Extrinsic. Not infrequently, processes of a physiologic, inflammatory or malignant nature occur pararectally and must be

distinguished from primary carcinoma of the rectum. A loculated pelvirectal abscess is diagnosed by the presence of a fluctuant mass in one or the other supralevator fossa, fied by *cystoscopy*. *Carcinoma of a seminal* vesicle is diagnosed by a history of difficult urination, elevation of the floor of the bladder, presence of a hard, *fixed*,

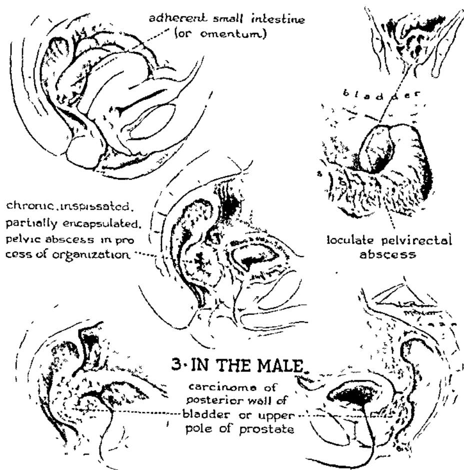


Fig. 475. Sagittal sections of abscesses and malignant growths in the male.

by *fever*, *malaise*, *leukocytosis*, *increased* sedimentation rate, etc. An adherent small intestine is diagnosed by previous operations, change in position and collapsibility. Carcinoma of the prostate is diagnosed by *a history* of difficulty of urination and retention, presence of a hard, fixed, nodular mass involving the prostate beneath the intact rectal mucosa. Carcinoma of the bladder is diagnosed by a history of painless *hematuria* and the presence of a hard, nodular mass well above the prostatic sulcus and beneath an intact *rectal mucosa*, verinodular mass below the bladder and above the prostate from which sulcus exists and an intact rectal mucosa. *Malignancy of the* uterus and ovary is diagnosed by rectovaginal and abdominal examination, and scybalum by the inconstant doughy consistency.

It is not uncommon for a process either malignant or nonmalignant in the immediate vicinity of the rectovesical or rectouterine sulcus to assume the form of an extension or shelf by impinging on the an*terior rectal wall. Quite appropriately*, such

is designated "Blumer's rectal shelf." The fact that metastatic growths from distant sites do encroach upon and even surround the rectum, causing symptoms referable to the lower bowel and findings misinterpreted as primary rectal malignancy, deserves more than cursory mention; and toward the avoidance of a radical extirpation in such a case, a thorough understanding of the condition in all of its phases is imperative.

The earliest reference to this entity is that by Strauss[970] in 1895, who reported a case of gastric carcinoma with metastasis to the pouch of Douglas. Four years later, two additional cases were cited, and mention was made that such metastasis may not only be early, but may be the only manifestation.[983] In 1908, Schnitzler[915] described 11 cases, in one of which the pancreas was the primary site. Worthy of mention is this quotation from his original German: "The important feature was that all these patients consulted the doctor for symptoms produced by the metastasis, without having the slightest suspicion of the presence of the primary growth." In his report, this investigator remarked that in one case he mistook the tumor for a primary rectal growth and performed a radical sacral extirpation. Examination of the patient, who survived six months, revealed a gastric carcinoma of long latency. Payr[788] described a case in which he performed a colostomy for rectal stenosis due to periproctitic and

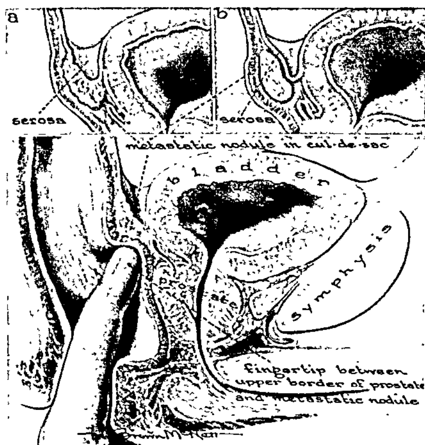


Fig. 476. Examining finger against extrarectal metastatic process. The mucous membrane is freely movable over the growth. (a) Supraperitoneal metastatic growth as seen in case of carcinoma. (b) Infraperitoneal metastatic growth as seen in sarcoma. (Bacon, H. E.: New York State M. J. 39:2267.)

parametritic induration. The patient died of peritonitis; autopsy revealed a gastric carcinoma and the presence of perirectal metastasis of the infiltrative type. Other cases were reported simultaneously by Bensaude and Okenczyc,[99] Brosch,[162] Chiari,[214] Kappeler,[531] Kaufmann,[535] Kelling,[540] Orth[775] and Toyosumi.[902] Blumer,[137] in 1909, reviewed the literature in addition to his report of two cases—one primary in the gallbladder and the other in the stomach. Because of his excellent description, this extrarectal site has been referred to frequently as "Blumer's shelf."

Since that time additional reports have been published.[43, 143, 174, 314, 479, 492, 537, 616, 648, 705]

Judging from the available literature at hand, as well as our own series of cases, the stomach is by far the most common primary site affected. Feldner[342] is quoted as saying that metastasis to Douglas' pouch occurs in 20 per cent of gastric carcinomas and in 18 per cent of gallbladder carcinomas. Such frequency we have been unable to confirm in our group of cases.

The occurrence of carcinomatous implants in the abdomen, especially in advanced cases, is not an uncommon feature. The explanation first mentioned by Schnitzler is today almost universally accepted—that pelvic involvement from a malignant stomach or gallbladder occurs by fragments of cancerous tissue gravitating to the pouch. Eusterman and Balfour[322] have said that it would seem that when the tumor reaches the gastric serosal layer, carcinoma cells are mechanically carried to the pelvis and there occasionally take root. In fact, they state: "Although the gastrocolic and greater omentums are favorite sites, the most common situation is the pelvic peritoneum." This, however, while quite possible and highly probable, does not explain entirely the occurrence of an isolated metastatic pelvic deposit in the absence of other visible and palpable implants. In two instances, sections of the smaller retroperitoneal lymphatics in the lower dorsal and lumbar regions presented evidence of malignant invasions. Some investigators contend that *lymphatic embolism and continuous permeation* are commonly associated. Ewing[328] considered it probable that the rapidly growing epidermoid and glandular carcinomas disseminate chiefly by lymphatic embolism, while the slowly growing and recurrent tumors often extend by continuous permeation. Retrograde flow through lymphatic and blood channels is a subject that always invites discussion. Organs in which there is a normal venous pulse, or where there occurs violent expiration or increase of intrathoracic pressure would be the most common sites. Occlusion of the main lymphatic or venous channels gives rise to disordered function, as a result of which retrograde flow, even though a slow process, may supervene. Examples of retrograde venous and lymphatic flow have been cited by Heller, Bonome, Arnold, Ernst and von Recklinghausen, Vogel, Poncet, Most and Troisier.

Walther[1020] is of the belief that a large number of the cases with alleged retrograde lymph node metastasis are instances of continuous dissemination, because in the majority of his cases he was able to demonstrate that diseased lymph nodes that were not in the vicinity of the primary growth were regional metastases of an organ that had become involved by the hematogenic route. This subject has been discussed previously.

Regarding breast carcinoma, Sampson Handley[439] said: "It must never be forgotten that the first sign of epigastric invasion may be found not in the epigastric region, but in the pelvis." He maintains that in nearly every case dissemination in the abdominal cavity occurs by transcelomic spread, with the secondary deposits arising from gravitations of cancerous particles into the pelvis; that in the late stage the whole pelvis may be filled with cancer and its contents matted together. Carnett[194, 195] concurred in the view that lymphatic permeation is a common process in

Table 66. Twenty-two Cases Treated Over Five-Year Period Ending December, 1938 (Author's Series)

Initials	Age	Sex	Race	Salient Symptom	Provisional Diagnosis: Cancer of	Digital Examination of Rectum: (Extrarectal Lesion)	Primary Site	Verified by	Type of Tumor	Grade
M. St. P.	47	F	W	Pain in stomach, nausea and vomiting, progressive constipation, loss of weight	Stomach	Large, hard, nodular mass anterior and outside rectal wall	Stomach	Necropsy	Adenocarcinoma	III
W. C.	67	M	B	Soreness about "umbilicus," weakness, and loss of weight	Rectum	Hard, nodular mass size of tangerine anterior to and encroaching on rectum	Stomach	Necropsy	Adenocarcinoma	III
W. H.	62	M	W	Pain in epigastrium, worse after eating	Stomach	Three nodular growths anterior to rectum, hard and immovable	Stomach	Necropsy	Adenocarcinoma	
A. G.	39	M	W	Abdominal pain, difficulty in swallowing, weight in pelvis		Two hard masses size of walnut anterior to rectum	Stomach	Necropsy	Adenocarcinoma	IV
J. C.	47	M	W	Epigastric pain, constipation, loss of weight	Stomach	Large, nodular mass size of first anterior to rectum	Stomach	Necropsy	Adenocarcinoma	IV
F. D.	60	M	W	Increasing constipation, vomiting, occasional diarrhea, loss of weight	?	Large, hard, nodular mass anterior to rectum	Stomach	Operation		
N. F.	55	M	W	Intermittent constipation and diarrhea, pain in lower abdomen	Rectum	Hard, collar-like nodular mass constricting rectum; partial obstruction	Stomach	Operation	Adenocarcinoma	
A. B.	43	M	W	Dull pain in stomach, worse after meals; some vomiting, tarry stools		Hard, constricting process outside rectum M.M. nonadherent	Stomach	Operation	Adenocarcinoma	
J. S.	51	M	W	Dull, agonizing pain about navel; black blood in stool, loss of weight	Rectum	Semicircular mass about rectum, hard and nodular, M.M. movable	Stomach	Operation	Adenocarcinoma	III
H. L.	69	F	W	Pain after eating, loss of weight, lumbar pain	Prostate	Small mass size of cherry anterior to wall of rectum. M.M. movable	Stomach	Operation	Adenocarcinoma	IV
H. C.	62	M	B	Abdominal pain, constipation, heaviness in rectum	Rectum	Large mass anterior to rectum causing encroachment. M.M. movable	Pancreas	Necropsy	Adenocarcinoma	
J. O'H.	70	M	W	Dull pain, worse after meals, loss of weight	Rectum	Mass size of egg anterior to rectal wall. M M freely movable	Pancreas	Necropsy	Adenocarcinoma	III
J. W.	49	M	B	Abdominal pain, tenesmus, loss of weight	Prostate	Horseshoe nodular mass causing marked constriction of rectum. M.M. movable	Pancreas	Operation	Adenocarcinoma	
M. C.	58	F	B	Abdominal pain, progressive constipation, loss of weight	Rectum ?	Discrete metastatic nodules in cul de sac	Common duct	Autopsy	Adenocarcinoma	
E. S.	53	F	B	Mass in abdomen		Large, fixed mass anterior to rectal wall	Recto-peritoneum	Autopsy	Neurogenic sarcoma	
D. McC.	50	M	W	Lower quadrant pain, loss of weight	Rectum	Nodule size of hickory nut anterior to rectum	Ascending colon	Operation	Adenocarcinoma	IV
J. L.	48	M	W	Costal pain, constipation, loss of weight	Prostate	Large nodular fixed mass anterior to rectum; causing partial obstruction	Ascending colon	Autopsy	Adenocarcinoma (colloid variety)	III
E. B.	59	M	B	Abdominal pain, frequent desire for stool	Rectum	Two nodules, size of large cherry, anterior and to right of rectum	Ascending colon	Biopsy	Adenocarcinoma	IV
A. M.	55	F	W	Dysphagia; progressive constipation	Rectum ?	Nodular mass left anterior to rectum. M M. slightly adherent; not ulcerated	Esophagus	Necropsy	Adenocarcinoma	III
H. G.	37	F	W	Egg-sized mass in breast, constipation	Breast and rectum	Nodules palpable anterior to rectal wall	Breast	Necropsy	Adenocarcinoma	IV
C. F	63	F	W	Lump in breast, increasing constipation, pain on defecation, loss of weight	Dual malignancy	Small collar-like mass constricting rectum; hard and irregular	Breast	Biopsy	Adenocarcinoma	
C. O.	55	M	W	Intermittent pain in right lower quadrant	?	Hard, collar like mass constricting rectum; discrete nodules	Kidney	Autopsy	Adenocarcinoma	

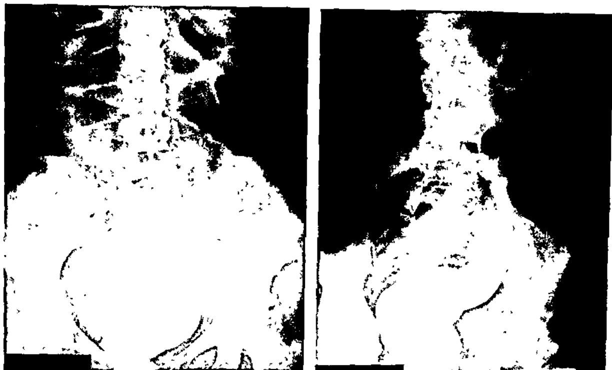


FIG. 477. (*Left*) Complete obstruction at the rectosigmoid due to large tumor. (*Right*) Complete obstruction at the junction of the upper and middle third of the sigmoid.

the liver and that in other parts, especially the deeper or pelvic parts of the abdomen, lymphatic permeation may begin around implanted nodules. He differed, however, in that he believed widespread lymphatic permeation may occur in the abdomen in the absence of implants.

During the five-year period ending 1938, as previously reported,[48, 49] the author observed 22 cases (Table 66). A perusal of this table shows that, in the majority of instances, symptoms referable to the lower bowel were cited by the patient, although not those symptoms so frequently stated that are suggestive of primary carcinoma of the rectum—namely, change in bowel habit, such as early morning diarrhea, frequency, urgent desire for and incompleteness of stool, and bleeding. In all, digital examination of the rectum elicited a hard mass of varying size and number anterior to, rather than in, its wall. In no instance was the rectal wall ulcerated. The prognosis in such cases is, of course, poor, since it usually represents a far advanced malignancy. Surgery, other than a palliative procedure, is contraindicated.

Over a period of 15 years, a group of 46 instances of upper abdominal and mammary malignancy with metastatic involvement of the pelvic sulcus has been observed, and while this series is not large, it represents true metastasis and not direct extension.

AUTHOR'S SERIES TO 1948

PRIMARY SITE	NO. CASES
Stomach	31
Pancreas	5
Common bile duct	1
Ascending colon	4
Breast	2
Esophagus	1
Kidney	1
Retroperitoneum	1
Total	46

Complications and Sequelae. Ulceration and severe hemorrhage not infrequently occur in advanced lesions. Extension to neighboring structures and metastases are seen usually in late and neglected cases. Intestinal obstruction may occur

from the tumor itself, from impaction, by a foreign body or pedunculated growth in a partially stenosed lumen or from kinking. It may be due to intussusception induced by the growth or to simple paralysis of the gut above the malignant process. Obstruction of the chronic type is by no means uncommon. In fact, from 50 to 60 per cent of patients with sigmoidal and rectosigmoidal malignancy show signs and offer symptoms, so that obstructive phenomena tend to dominate the clinical picture. It has been estimated that obstruction to the left colon occurs six times as often as to the right. However, the incidence of acute intestinal obstruction from lesions in this locality is small. Rankin and Graham,[851] in a series of 381 cases of carcinoma of the rectum and colon, record the performance of cecostomy in four cases and enterostomy in two. They report an incidence of 5 per cent, which is similar to that of Stone and McLanahan.[908] In our series of cases from Group A, there were 28 patients with acute intestinal obstruction, an incidence of 3.5 per cent. Peritonitis may result from rupture of the sigmoid above the cancer or directly through the ulcerated wall.

Bargen and Cox[83] noted acute perforation in 9.3 per cent of their cases. Secondary infection is common, especially in ulcerated lesions, and may often account for an otherwise unexplained elevation in temperature, *moderate leukocytosis and general signs of* toxic absorption. Fistulae, both single and multiple, have not been too infrequent in our experience. Invasion of other structures, such as the perianal skin, the urethra, bladder and especially the vagina, with resulting fistulae have been encountered. For sigmoidal lesions, there have been several instances of fistulae between the pelvic colon and the small bowel and/or bladder.

PROGNOSIS

Many factors bear influence on the prognosis of patients with malignancy of the lower bowel. These will be considered under the following headings:

Gradation of Growth. The gradation of malignant tumors according to cell differentiation and mural penetration has been discussed elsewhere in detail (see p. 650). Suffice it to say that it has been shown that the probable duration of life following re-

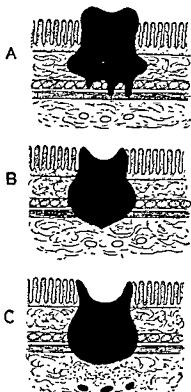


Fig. 478. Extent of spread of cancer of rectum. (Dukes: The classification of cancer of the rectum, *Collected Papers, St. Mark's Hospital, London*, Lewis.) (A) Growth limited to wall of rectum. (B) Extension of growth to extrarectal tissues but no metastases in regional lymph nodes. (C) Metastases in regional lymph nodes.

section can be calculated with fair accuracy on the basis of tumor gradation. Broders'[158, 159, 160] classification is based on cell differentiation by microscopic grading of the neoplasm.

The more nearly the cell approaches the embryonic or undifferentiated type, the more malignant the tumor; and conversely,

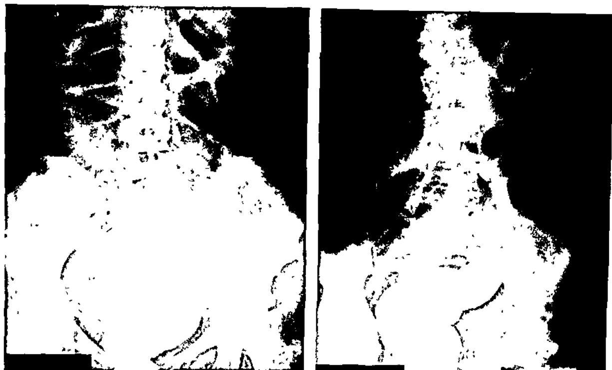


FIG. 477. (*Left*) Complete obstruction at the rectosigmoid due to large tumor. (*Right*) Complete obstruction at the junction of the upper and middle third of the sigmoid.

the liver and that in other parts, especially the deeper or pelvic parts of the abdomen, lymphatic permeation may begin around implanted nodules. He differed, however, in that he believed widespread lymphatic permeation may occur in the abdomen in the absence of implants.

During the five-year period ending 1938, as previously reported,[48, 49] the author observed 22 cases (Table 66). A perusal of this table shows that, in the majority of instances, symptoms referable to the lower bowel were cited by the patient, although not those symptoms so frequently stated that are suggestive of primary carcinoma of the rectum—namely, change in bowel habit, such as early morning diarrhea, frequency, urgent desire for and incompleteness of stool, and bleeding. In all, digital examination of the rectum elicited a hard mass of varying size and number anterior to, rather than in, its wall. In no instance was the rectal wall ulcerated. The prognosis in such cases is, of course, poor, since it usually represents a far advanced malignancy. Surgery, other than a palliative procedure, is contraindicated.

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Total	46

Complications and Sequelae. Ulceration and severe hemorrhage not infrequently occur in advanced lesions. Extension to neighboring structures and metastases are seen usually in late and neglected cases. Intestinal obstruction may occur

Loss of Weight. Impressed with the findings of Pack and others relevant to their cases of stomach cancer, we reviewed the records of our patients with rectal malignancy and observed a close correlation between marked and progressive loss of weight and the rate of survival following radical resection. By no means should loss of weight serve as an index to irresectability, for such can rarely be determined prior to exploration.

Location of the Growth. Both Pruitt[820] and Gabriel[115] are of the opinion that the prognosis increases from below upward. Lockhart-Mummery[622] considers the most favorable case to be one that is of small size, situated low on the posterior wall, freely movable on the deep tissues and projecting into the rectum. On the other hand, an unfavorable case is one that is located high in the rectum, almost completely surrounding the lumen, and is fixed. Fansler concurs in this view and places most importance on the degree of fixation. As is recognized, metastasis is more frequently met with in fixed growths than in those that are movable. Likewise, a thick-stalked tumor set close to the bowel wall and firmly fixed to the deeper layers carries greater potential danger than one that is pedunculated, and further the majority of these pedunculated tumors show a rather low-grade malignancy. Fixation to neighboring structures, such as the bladder, prostate, sacrum or pelvic wall, alters the prognosis.

Comparative statistics according to location of the growth in various segments of the lower bowel are appended (see p. 650, cancer). Correlation of the gross types, degree of ulceration, percentage of circumferential involvement, frequency of regional lymph node invasion and size of the growth in terms of prognosis are shown on page 649. A comparative study of the survival rates of patients with cancer in various portions of the large bowel as tabulated by Mayo is as follows:

	With Nodal Involvement	Without Nodal Involvement
Right colon five-year cures	39%	66%
Left colon five-year cures	20%	56%
Rectum five-year cures ...	20%	48%

Obstruction. The presence of obstruction may readily prove a compromising factor. Growths in the sigmoid, including the rectosigmoid, are prone to become obstructed in a fair percentage of cases, but following surgical decompression, resection is frequently possible and may usually be carried out with relative ease. Rectal growths have less tendency to obstruct, but after surgical decompression, resection not uncommonly is more difficult, compared to lesions of the left colon.

Perforation. Perforation of the bowel due to carcinoma may be extremely serious and quite possibly fatal. This is especially true where several days have intervened and gross contamination of the peritoneum has occurred. On the other hand, once the diagnosis is made or suspected, prompt and adequate surgical drainage using one or more sump drains with continuous suction, possibly exteriorization if in the mobile sigmoid, probable proximal colostomy, and the intraperitoneal and parenteral use of the sulfonamides, penicillin and streptomycin have proved of utmost advantage.

ASSOCIATED CONDITIONS, PHYSIOLOGIC AND PATHOLOGIC

During the past few years we have encountered rather varied conditions associated with or serving as a complicating factor in lower bowel malignancy. In some instances they have offered a distinct problem. For the purpose of description, these will be discussed below.

Physiologic

As is common knowledge, the combination of pregnancy and rectal cancer is rare. As previously reported,[66] we examined four

the more nearly normal the tumor, the less malignant it is. Those in which there is a high proportion (from 100 to 75 per cent) of differentiated cells, are classified as Grade I; those in which the proportion is reduced to from 75 to 50 per cent are classified as Grade II; from 50 to 25 per cent, Grade III; and 25 per cent or less, Grade IV. Grades I and II offer relatively good results following surgical treatment; whereas, in Grades III and IV, the prognosis is increasingly poor.

The following table compiled by Graham discloses the incidence of five-year cures according to gradation of tumor.

Age. Available evidence is at hand to show that the younger the patient the more unfavorable is the prognosis. According to Babcock,[31] carcinomata occurring before the age of 35 are rarely curable.

Sex. Females as a group are offered greater prospects of longevity following resection than males.

General Condition of the Patient. Both the extremely obese and the markedly undernourished patients are poor surgical risks. In the latter, with appropriate treatment (see Chaps. 27 and 28 on Preoperative and Postoperative Treatment), the status of these individuals can be improved to a degree where they withstand a formidable procedure with relative ease. Complicating diseases, such as marked arteriosclerosis, advanced cardiorenal disease, extreme hypertension and diabetes, may readily influence the immediate risk as well as the prognosis.

	No. Cases	Grade I	Grade II	Grade III	Grade IV
Number	753	101	434	157	61
Incidence	. .	13%	58%	21%	8%
Five-Year Cure		63%	51%	31%	24%

Following removal, the prognosis may be ascertained by the extent of spread, according to Dukes' classification,[304] which is divided into three groups. (Fig. 478.) In Group A, the growth is confined to the wall of the rectum, not having progressed beyond its muscular coat. This author believes that by excision the disease is completely eradicated. In Group B the perirectal tissues are invaded. Here the prognosis is good, but less favorable than in Group A. Group C, which represents penetration through the muscle coat and into the perirectal tissues with involvement of the regional lymph nodes, has a very unfavorable prognosis. The value of such a classification is evident.

Employing Dukes' classification of rectal cancer, Norbury has tabulated the five-year survival in the accompanying chart:

Duration of Symptoms. In general it may be stated that the longer the duration of symptoms, the greater is the opportunity of extension and metastasis. McVay[702] estimated that at seven months the lymph nodes were involved in 17 per cent of the cases studied; at 10 months, 47 per cent; and at 11 months, 71 per cent; so that the prognosis may be considered less favorable as the duration of symptoms is increased. This fact alone shows the value of early diagnosis and removal.

Group	Cases Surviving Operation	Untraced	Deaths Due to Cancer	Deaths Due to Other Causes	Case Summary 5 Years	Percentage 5-Year Survival
A	10	0	0	3	8	100%
B	26	0	5	3	18	78%
C	45	0	24	2	19	44%
Total	81	0	29	8	44	60%

lowing spontaneous abortion in a patient seven months pregnant. The mortality is computed as 25 per cent. All patients reached term uneventfully. Cesarean section was performed in three instances.

Finn and Lord,[319] in the same year, presented a case of carcinoma of the sigmoid with obstruction complicating pregnancy. A three-stage operative procedure was successfully instituted, preliminary transverse colostomy with later resection of the growth and end-to-end aseptic anastomosis. This was the first recorded case of cancer of the colon producing obstruction in pregnancy with survival of the mother and baby. From the manner in which this case was handled, one must conclude that Finn and Lord had no fear of dealing with malignancies in the large bowel during pregnancy, so far as peritonitis and postabortal infection were concerned. Although they did not render an opinion as to how carcinoma of the lower bowel complicating pregnancy without obstruction should be handled, one would assume that with present-day adjuncts, such as sulfonamides, penicillin and streptomycin, extrapelvic lesions of the large bowel could be managed with relative disregard of the pregnancy. In our review of the literature only one other case of pregnancy complicated by an obstructing bowel lesion was found. Smits, in 1902, cited a case of a 27-year-old primipara eight months pregnant with obstruction from an inoperable cancer of the rectum. Cesarean section was performed with resulting viable fetus and dead mother. Quite recently, Swartley *et al.*[977] reported a case of perforated carcinoma of the rectum in which cesarean section, hysterectomy and abdominoperineal resection were performed with surviving mother and child.

As has been stated in previous articles, there is little mention made of this complication of pregnancy in the standard textbooks on obstetrics. Curtis does make a brief statement stating, "Malignant tumors of the rectum are sometimes so extensive that delivery from below is absolutely contraindicated." The English authors, Berkeley, Bonney and MacLeod,[103] advocate management of these cases under four phases: (1) acute obstruction; (2) the presence of an operable tumor prior to obstruction; (3) an inoperable lesion without obstruction and (4) dystocia. For the first condition they recommend—regardless of the duration of pregnancy—hysterotomy, colostomy and later resection. If the tumor is considered operable and there is no obstruction, they recommend hysterotomy, colostomy and later resection. They consider two alternatives to the latter procedure: (1) to empty the uterus, remove it, perform a colostomy and later resect the growth, or (2) empty the uterus, remove it and resect the growth simultaneously. If the lesion is inoperable but not obstructed, they prefer hysterotomy and colostomy in the early months of pregnancy, but in the later months, recommend conservative measures until viability, then cesarean section and colostomy. If dystocia is present, cesarean section and colostomy are advised. They mention that in 5,478 collected cases of cesarean sections, 16 were performed for obstruction of the pelvic outlet by carcinoma of the rectum, but no accurate references are made. Stander[953] discusses an instance of obstruction of the pelvic outlet by carcinoma of the colon. He feels that the pregnancy should be disregarded except in those cases where the lesion is discovered in the last two months. He also states that necessary operations may be performed during pregnancy without undue fear or hesitation. Adair[4] is of the opinion that it is desirable to interrupt pregnancy as soon as possible after the diagnosis of cancer of the rectum is made, if there is any possibility of cure. He has been impressed with the fact that cases of primary or secondary carcinoma in close proximity to the female generative organs have been observed to spread with greater rapidity during pregnancy and advises resection of the rectum soon after the pregnancy is terminated. He also suggests the use of radium in selected cases. In the last trimester, he thinks that cesarean section with removal of the rectum after recovery is the procedure of choice.

In the final analysis, 71 cases of malig-

private patients, all of whom presented cancer of the rectum, one occurring during the third month of gestation and three shortly after delivery. More recently, another patient two months pregnant was successfully resected. Because of its rarity and since the appropriate treatment has not been clearly defined, our senior resident, Dr. Robert J. Rowe, undertook the task of reviewing the literature in English and foreign tongues for the purpose of arriving at more definite conclusions than have heretofore been presented. Our historical sketch is as follows:

In 1837, Jean Cruvilhier[252] recorded a case of gelatinous carcinoma of the rectum in a 30-year-old patient at full term on whom a version was performed with death of both mother and baby. A few years later, in 1843, Lever[606] reported a similar case and cited others which had caused obstruction to the pelvic outlet. In 1879, Kaitenbach[524] performed the first cesarean section for obstruction of the pelvic outlet due to rectal cancer. This resulted in the immediate death of the baby and later death of the mother from peritonitis. It was not until 1893 that a cesarean section was accomplished by Freund,[370] although subsequently other cases were reported in which both the mother and baby survived.[73, 363, 423, 473, 483, 518, 811, 871, 1081] At the turn of the century, Krause[567] reviewed the available literature and found 14 cases.

Demelin and Coudert, in 1902, also reported a case in which malignancy of the rectum complicated pregnancy. The lesion was primarily thought to be syphilitic when discovered in the first trimester, for which reason the patient was carried to term, when cesarean section and hysterectomy were performed. The baby survived, but the mother died. The following year, Russell[893] reported a 27-year-old patient, para VI, whose case proved to be inoperable. He discussed in some detail 21 cases and concluded: (1) if early in the pregnancy, labor should be induced and radical operation performed at a later period; (2) in advanced pregnancy with a viable fetus, cesarean section, hysterectomy and detachment of the rectum should be performed, so that a Rehn or Liermann procedure may be completed later per vaginam. Later, Nijhoff[759] discussed the occurrence of a rectal cancer in an 18-year-old female, seven months pregnant. He considered the lesion inoperable and allowed the patient to go on to term with spontaneous delivery of a normal infant. Needless to say, the mother died. He found 22 cases previously reported.

In 1908, Mlle. Tchebotarevsky,[984] in her thesis for a doctorate in medicine, entitled *Dystocie par tumeurs du rectum,* presented a most comprehensive review of the literature, including 35 cases. She added those of Herman,[461] Potter,[817] and Simpson as reported by Russell.[893] In conclusion she advocated (1) removal of operable tumors as soon as possible; (2) termination of pregnancy before operation unless it was early and there was a possibility of preserving the pregnancy even with radical operation; (3) preliminary colostomy if the cancer was inoperable. The following chart shows the fetal and maternal mortality in this group of 35 cases.

	Cases	Fetal Mortality	Maternal Mortality
Cesarean section	14	3 died	8 died
Extraction (forceps, version, etc.)	8	3 "	4 "
Induced abortion	4	2 "	0 "
Spontaneous abortion	3	3 "	2 "
Spontaneous at term	4	0 "	0 "
Other cases	2	1 "	1 "
Total number of cases	35	12	15

Other cases were cited by Riemann,[872] Clemenz[224] and Kynoch.[579] Pedersen[789] collected 41 cases in which there were 15 maternal deaths either during or in connection with parturition. In 20, the diagnosis was made during pregnancy, in 19, prior to or during parturition, and in two, after delivery.

In 1926, Kaspar and Katz[533] presented an excellent treatise on this subject, reporting 18 cases operated upon in the Hochenegg Clinic. Two cases of carcinoma of the sigmoid with obstruction complicating pregnancy were recorded by Der Brucke[282] in 1940.

Banner, Hunt and Dixon,[79] in 1945, offered an excellent contribution, reporting ten cases. Three were carcinoid tumors of the appendix, only one of which was removed during pregnancy. Another was a malignant polyp of the rectum apparently extirpated by local excision or fulguration. In two, pregnancy occurred some four years following the operative procedure. Thus there were four cases of malignancy of the lower bowel which complicated pregnancy. Operative removal of the growth was instituted in all with one death. Apparently this occurred from uterine sepsis fol-

4.9%), only six were due to peritonitis.

In 1927, Mussey and Crane[750] concluded that operations of necessity should be performed in pregnant women without too much concern. DeLee, Greenhill, Stander and Curtis concur in this view, but such a belief is not expressed where the malignancy is located in the rectum. It is our opinion that there is very little difference in an operation on the distal bowel during pregnancy than in other abdominal operations. As instituted in the first case reported, we recommend radical surgical extirpation of the cancerous rectum and gland-bearing areas with relative disregard to the pregnancy. Estrogenic substances should be employed in an effort to prevent abortion. Induced abortion is contraindicated. The investigations of Maud Slye would seem to offer sound evidence that pregnancy does not stimulate extragenital cancer (the breast excluded). If such is true, there is no good reason for the performance of hysterectomy. Later, when the size of the pregnant uterus interferes with the removal of the cancerous growth, the problem is altered. Here the factor of emptying the uterus must be considered, if a one-stage procedure such as the abdominoperineal proctosigmoidectomy or Miles type of excision is to be employed. While we cannot recommend colostomy and posterior excision (Lockhart-Mummery) in these cases, it may be considered a second choice. While the mortality rates are low in the few cases quoted, four fecal fistulae and sloughs of the bowel occurred, and no conclusions could be drawn regarding the rates of survival. It must be admitted that greater completeness of excision can be obtained by a combined abdominoperineal extirpation than simply by colostomy followed by perineal excision. Regardless of that which is considered best for the mother, religion or a desire for children may alter the surgical program by the necessity of preserving the pregnancy.

Where the pregnancy is at or near term, cesarean section is recommended to avoid compression of the tumor mass and possible dissemination of the cancer cells by the pregnant uterus. From two to four weeks later, radical extirpation should be performed. However, under certain circumstances, it may be prudent to perform the section and extirpation simultaneously.

Where the growth is inoperable, the fetus is to be considered of primary importance, but unless the lesion is obstructing, there is no sound reason for a palliative colostomy, as advocated by others, particularly if cesarean section will be necessary. In the presence of obstruction, the pregnancy should be totally disregarded and surgical means of decompression immediately instituted. Our preference would be a transversostomy through a small Singleton incision and later removal of the cancerous bowel by proctosigmoidectomy. For extrapelvic lesions, such as of the sigmoid, end-to-end anastomosis with complemental appendicostomy is preferred, although a modified Mikulicz exteriorization procedure may be performed. The fact that these patients usually fall into a younger age group, that the excreta from the abdominal colostomy may serve as a source of contamination at the time of abdominal section and that both husband and wife are loathe to participate in normal marital relationship should militate against the establishment of a permanent abdominal colostomy in favor of a perineal anus.

As stated in the beginning of this discussion, five patients with cancer of the rectum have come under our care. In all of these, the author performed an abdominoperineal proctosigmoidectomy without colostomy and with preservation of the sphincter musculature with uneventful recovery. Two cases are reported herewith:

Case I (T.U.H. 118167), Mrs. K. C., a white female, age 34, was first seen in consultation on May 1, 1946. At that time she complained of bleeding and a discharge of mucus from the rectum. The bleeding had existed for

nancy of the lower bowel complicating pregnancy were found in the literature. The cases in which symptoms began during pregnancy have been included, although they are not as important, conclusively, as those in which the pregnancy was actually complicated by the malignancy either during the prenatal period or during parturition. There were 37 cases in which the malignancy was considered operable and 24 cases in which the growth was thought to be inoperable. There were 10 cases which, for various reasons, were not included in either group. Since our chief interest was in the cases where operation was a factor, the latter group was not included in the statistical survey.

The 36 cases in which operation was a factor were divided into two groups: (1) 24 cases in which the operation was performed during pregnancy, and (2) 12 cases in which operation was performed following abortion or delivery.

Our chief concern is with the first group. Operation was performed in one case at 2 months, five at 3 months, two at 4 months, three at 5 months, three at 6 months, four at 7 months, one at 7½ months and four at 8 months. Operations were as follows: five Hochenegg, five Kraske, three Lockhart-Mummery or similar types, one Von Rehn, one Mikulicz, one Hartmann or anterior resection, one subsacral resection, one transverse colostomy with later resection and end-to-end anastomosis, two Miles resections, one "anal method," one removal through vagina and two in which operation was unknown. In addition, there were one stillborn at 7 months after a Hochenegg operation, the death of the mother and fetus following peritonitis after a Hartmann operation and the death of a patient 6 months pregnant, five days after a Kraske operation. There were two cases in which the outcome was not known. Excluding these two cases and the inoperable cases mentioned above, there remained 20 cases in which three fetal and two maternal deaths occurred. This represents a fetal mortality of 15 per cent and a maternal mortality of 10 per cent.

In reviewing the literature, it is evident that many of the tumors were undiagnosed until labor had begun. More than occasionally, symptoms of the cancerous growth were masked by those occurring during the pregnancy. Constipation, and occasionally obstipation, were fairly constant symptoms. Actual obstruction occurred in eight cases. Pain at stool, usually nonexistent, was present in several cases. Loss of weight occurred frequently. Bleeding, although frequent, was not as common as is usual in cancer of the rectum. In three instances vomiting was mistakenly thought to be of the pernicious type. Ages ranged from 18, in Nijhoff's patient, to 43, in Heusner's.

In 33 of the cases, the average distance of the lesion from the anal margin was 10 cm. Thirty-one cases were reported as located in the rectal ampulla and would probably have averaged the same distance. Six cases were in the sigmoid colon and one in the ascending colon. Two of the latter were reported by Kaspar and Katz as multiple carcinomas. Certainly in the group of 33 cases and probably in the second group of 31, digital examination would have revealed the presence of the neoplasm.

Discussion of Treatment. Because of disagreement in the management of lower bowel malignancies complicating the various trimesters of pregnancy, it is deemed expedient to offer a few pertinent remarks concerning the treatment to be instituted. Previous to operation, the advisability of therapeutic abortion, hysterectomy or hysterotomy was evaluated most carefully. The fear of postabortal infection, either induced or spontaneous, seemed greatly magnified, especially since the incidence of peritonitis following operation on the large bowel has been so markedly reduced in recent years. It may be mentioned that in our series of 401 proctosigmoidectomies for cancer, from which there were 20 deaths (mortality

infiltrated with inflammatory cells. The lymph nodes are free of tumor.

DIAGNOSIS: Adenocarcinoma, grade II, of rectosigmoid; two adenoma malignum.

The patient was subsequently delivered of a normal child by Dr. J. Quinlen. Double-contrast enema in May, 1948, disclosed a polypoid process in the descending colon just distal to the splenic flexure. Two months later (July, 1948) the patient was explored and the remaining colon carefully palpated for additional lesions. The bowel was slit and the adenomatous polyp removed. Through the incised gut a sterile sigmoidoscope was introduced in each direction to determine the presence of additional growths. The single lesion removed was reported adenocarcinoma, Grade I. The patient's postoperative course was uneventful. (Condition satisfactory, Dec., 1948.)

The five cases are summarized in Table 67.

TABLE 67
(Author's Series)

MALIGNANCY COMPLICATING PREGNANCY

NAME	AGE	RACE	LOCATION	CIRCUMFERENCE	DUKES	BRODERS	DURATION	RECTAL SYMPTOMS	PERIOD OF PREGNANCY
K. C.	34	W	Midrectum	⅓	A	II	3 mos.	Bleeding; protrusion; pain	3 mos.
J. F.	23	W	Midrectum	⅓	B	II	6 mos.	Bleeding, protrusion	2 mos.

MALIGNANCY COMPLICATING POSTPARTURIENT PERIOD

NAME	AGE	RACE	LOCATION	CIRCUMFERENCE	DUKES	BRODERS	DURATION	RECTAL SYMPTOMS	PERIOD SINCE DELIVERY
M. K	35	W	Midrectum	⅔	B	II	5 mos.	Loose stools	2 mos
P. G.	35	W	Rectosigmoid	Entire	C	III	10 mos.	Bleeding; frequency of stool; loss of weight	3 mos.
H T.	37	W	Midrectum	Entire	A	II	5 mos	Bleeding; frequent evacuation; loss of weight, 8 lb.	9 mos.

PROCEDURE

NAME	OPERATION	OUT OF BED	DISCHARGE DAY	COMPLICATIONS	DISPOSITION OF CHILD
K. C	Abdominoperineal proctosigmoidectomy	6th	11th	None	Spontaneous abortion 3 days after arrival home
J. F.	Abdominoperineal proctosigmoidectomy	5th	11th	None	Pregnancy not interrupted
M. K.	Abdominoperineal proctosigmoidectomy	6th	11th	None	Living and well
P. G	Abdominoperineal proctosigmoidectomy	6th	11th	None	Stillborn
H. T.	Abdominoperineal proctosigmoidectomy	6th	16th	None	Living and well

one month, was bright red in color and admixed with the stool. For the past two or three months she had experienced continual discomfort in the "rectal region." The bowel evacuations had been more frequent for the previous month; they were, however, complete and satisfactory. No history of diarrhea, constipation, weight loss, urinary or any other gastrointestinal symptoms was elicited. Patient had a six-months-old baby and thought she was pregnant again, since she was not nursing the child and had not menstruated. She had two other children living and well (age 6 and 2). Past history: no operations or serious illness. Family history: mother living and well, age 75; father living and well, 73. One stepsister had tuberculosis; no history of malignancy. Physical examination revealed a well-nourished white female apparently in good health. The abdomen was flat and the abdominal musculature somewhat flaccid, but no masses or tenderness were noted. Digital examination of the rectum revealed a nodular cauliflower-like growth with everted edges, broad base and ulcerated center, located approximately seven centimeters from the anal margin and appearing to involve approximately one-third of the bowel wall as well as the rectovaginal septum. No other abnormalities were noted. The patient was admitted to Temple University Hospital on the Proctologic Service on May 3rd. Laboratory findings were as follows: Urinalysis, sp.gr. 1.028, no pus cells, sugar or albumen, pH 6.0; hemoglobin, 14.1 Gm. (91.7 per cent); R.B.C. 4.50; color index 1, leukocytes 8,800; hematocrit 45 cc.; prothrombin normal; bromsulfalein and cephalin flocculation within normal limits; serum chloride, 359 mg., total serum protein, 6.8 Gm. with normal a/g ratio. Preoperative cystometric reading was within normal limits. Cystoscopy revealed no pathology. The gynecologic consultant believed the patient was from two and one-half to three months pregnant and advised proceeding with abdominoperineal proctosigmoidectomy and estrogen, 10 mg. daily, prior to and following operation.

The patient was prepared in the usual manner with low-residue, high-caloric, high-protein diet and sulfathalidine orally, as is customary in all resections. An abdominoperineal proctosigmoidectomy was performed on May 13, 1946. No difficulty was encountered at operation except for the size of the uterus and enlarged veins in the pelvis. No metastases were evident. Immediately following operation, the patient suffered a drop in hematocrit to 34 and in serum protein to 4.8, for which reason plasma and blood were administered. Except for a moderate degree of distention on the fourth and fifth days, her recovery was uneventful. The patient was out of bed on the sixth, the redundant bowel was removed on the 9th, and the patient was discharged from the hospital on her 11th postoperative day. On the 14th postoperative day, while at home, she aborted spontaneously and completely without apparent complications. At the present time (December, 1948) she is well and has excellent sphincteric action.

Case II (T.U.H. No. 122857), Mrs. J. F., a white female, age 23, was seen in consultation October 7, 1947. Following a fall from a horse, in 1945, she experienced bleeding and protrusion. In March, 1947, a left oophorectomy was performed because of left lower quadrant pain. Subsequent to this operation, bleeding by rectum became apparent, but she was not examined until six months later, when a carcinomatous process was found in the upper ampullary portion of the rectum by Dr. H. Schneider. At the time of this examination her obstetrician was of the opinion that she was six weeks pregnant, which was confirmed by Frank test.

On October 14, 1947, an abdominoperineal proctosigmoidectomy was performed without colostomy and with preservation of the sphincter musculature. Her convalescence was uncomplicated, and she was out of bed the fifth day. Estrogen, 10 mg., was administered twice daily over a four-day period. She was discharged the eleventh postoperative day.

Histopathologic report: B — ulcerated tumor; B1—large polypoid structure; B2—small polypoid structure; B3—tiny polypoid structure; B4—lymph nodes. A segment of large bowel measuring 27 cm. in length. A tumor mass measuring 3 cm. in diameter, flattened and papillary in appearance, is found 13 cm. from the distal margin. One cm. below this tumor is a large, pedunculated, polypoid structure measuring 3 cm. in diameter and with a stalk 3 cm. long. Alongside of this mass is another smaller similar structure. There is a tiny polypoid structure 1 mm. in diameter, 5 cm. from the other end of the specimen. The ulcerative tumor does not appear to penetrate the bowel wall grossly. Four lymph nodes are found in the attached mesenteric fat.

The large and small polypoid structures are adenoma malignum, the tips of whose villous processes have undergone frank adenocarcinomatous change. The tiny polypoid structure is a redundant piece of mucous membrane whose glands are hyperplastic, with the stroma

rectum, with adenomatous polyps in the rectum and sigmoid visualized by the sigmoidoscope, how may the absence of additional processes of small size in the colon be determined other than by repeated opaque enemata with air inflation performed by expert roentgenologists and careful inch-by-inch manual interpretation of the entire colon during exploration? Independent of how well the bowel may be prepared, small particles of fecal material, a diverticulum or even a fatty tab may tax one's ingenuity. In one instance, with a known rectal carcinoma, where adenomatous polyps were known to be associated in the lower bowel but the roentgenograms were questionable, we performed a temporary transversotomy and inspected the lumen proximally and distally with the sigmoidoscope. This was closed immediately. The high sigmoid was then exteriorized through a separate incision, the bowel walled-off and slit. Through the proximal sigmoid the bowel was inspected as far as the splenic flexure to a point which was visualized through the transversotomy. The double-barrelled colostomy was permitted to remain for 10 days. At the next operation, through a left paramalian incision, the distal sigmoid and rectum were mobilized as is done with proctosigmoidectomy and the double-barrelled colostomy anastomosed and dropped into the abdomen. Both abdominal wounds were closed, and the bowel was pulled through from below with the sphincter preserved. As described elsewhere, hemicolectomy and proctosigmoidectomy for polyposis or for cancer associated with polyposis and transplantation of the transverse colon to the anus have proved quite satisfactory in the few instances in which they were employed (see p. 883).



Fig. 479. Massive sarcoma of the anus. (C. F. Martin.)

Lymphogranulomatous Venereal Stricture. Several instances of lower bowel malignancy associated with inflammatory stricture on the basis of lymphogranuloma venereum have been recorded in the literature.[133, 193, 271, 276, 432, 472, 600, 744, 823] As previously mentioned, we encountered one patient with malignancy of the rectum (adenocarcinoma Grade II) and found stricture in a male in his early thirties. Resection

Pathologic

Chronic Ulcerative Colitis. The association of malignancy and chronic ulcerative colitis is not so uncommon as one would be lead to believe, for as has been expressed on many occasions, irritation, trauma and infection are possible precursors of carcinoma. Renshaw and Brownell[963] found two cases of carcinoma in 336 instances of *chronic ulcerative colitis. They* further noted that one per cent (17 cases) of all cases of carcinoma of the colon and 38 per cent (128) of all cases of ulcerative colitis occurred in persons under the age of 30. The incidence of carcinoma of the colon with chronic ulcerative colitis, namely, 1.5 per cent, was higher than the incidence without ulcerative colitis (1 per cent). Helmholz *et al.*[463] studied a group of 95 children and 871 adults with chronic ulcerative colitis. The incidence of malignancy in the former was computed at 6.3 per cent, compared to 3.2 per cent in the latter. Streicher,[971] in a series of 217 cases of chronic ulcerative colitis, found three instances of malignancy (1.2 per cent), whereas Sauer and Bargen[991] reported 26 cases with ulcerative colitis and carcinoma. Bockus[138] found three cases of malignancy in a series of 200. Additional cases have been reported.[141, 169, 204, 208, 297, 490, 642, 675, 939, 1069] In our group of 324 cases of chronic *ulcerative colitis, there were two instances* of carcinoma of the rectum (0.61 per cent). On the other hand, in our series, Group A, of 800 cases with cancer of the lower bowel, there were seven in which ulcerative colitis was associ*ated (0.87 per cent).*

The surgical management of a malignant process with this type of colitis may readily be a problem if immediate re-establishment of bowel continuity is contemplated. Because of thickening of the bowel walls and the ulceration, studies should be instituted to determine the degree and extent of the ulceration and the surgery designed accordingly. In one *instance* we successfully performed a one-stage left hemicolectomy and proctosigmoidectomy and transplanted *the transverse colon to the anus* in a young woman 31 years of age because of carcinoma of the rectum and a chronic ulcerative process involving the entire rectum, sigmoid and descending colon. A second patient was operated upon by a Miles procedure—the ulcerative process having involved the rectum and sigmoid. Here, a permanent colostomy using the descending colon was estab*lished. This patient also made a satisfactory* recovery.

Diverticulitis. The incidence of diverticulitis associated with malignancy is variable, as shown by Abel, who cites the extremes as 1.7 and 8 per cent. A few reports are available.[22, 337, 512, 688, 766, 773, 845, 886]

Mailer,[647] in a published article of 8 cases, concluded that the cancer had its *origin in the lumen of the bowel* and not in the diverticulum itself. In our group there were several where diverticula were found on opening the extirpated specimen of bowel, but the incidence has not been computed. There were three cases of rectal cancer, however, two of which, upon exploration of the abdomen, showed an extensive diverticulitis of the sigmoid. In one, a modified Mikulicz resection was performed, followed by perineal excision and later closure of the colonic stoma. In the second, a Miles excision was performed. The third, which was the only one of the three studied roent*genologically, sought counsel elsewhere.*

Intestinal Polyposis. The subject of true polyposis and malignancy, as well as true polyposis and pseudopolyposis, has been discussed at length elsewhere. Suffice *it to state that the incidence of carcinoma* in adenomatous lesions is extremely high. During the past few years we have encountered sixteen cases of polyposis. Careful histologic study by serial section disclosed malignancy in 62.5 per cent of cases. As previously mentioned, the management of these patients is extremely difficult insofar as frank difficulty is encountered in determining the true extent of the process. Given a case of known malignancy of the

cular and metastasize early by the blood stream. Local invasion is less than that in carcinoma.[527] They may be primary or secondary and single or multiple. They begin as a small nodule in the perirectal fascia or, as is usual, in the submucosa, so that the overlying mucosa is at first movable. Polypoid growths protruding into the bowel lumen have been described.[78] These growths rapidly increase in size and become fixed. Ordinarily this increase is more rapid than that seen in carcinoma. Varying in size from a pea to a child's head,[97] sarcomata are found to be either round, firm and hard, sometimes nodular, or soft and spongy, depending on the amount of fibrous tissue present. Degenerative changes, especially ulceration and necrosis, are not uncommon.

Histologically, sarcomata are divided into (1) melanotic sarcoma, (2) fibrosarcoma and (3) lymphosarcoma. Cytologically, sarcomata have been classified as (1) leiomyosarcoma, (2) fibrosarcoma, (3) myosarcoma, (4) angiosarcoma and (5) malignant lymphoma or reticulum-cell sarcoma.[385] Ewing presented a clinical classification of rectal sarcomata as follows: (1) fibrosarcoma, (2) miscellaneous type to include a small number of ill-defined and imperfectly described varieties such as the melanotic or pigmented sarcoma, (3) lymphosarcoma and (4) leiomyosarcoma.

Malignant Melanoma. Melanotic sarcoma, *malignant melanoma or melanoblastoma* is of rare occurrence. If the eye is excluded, the most frequent site is the anorectum. According to compiled reports,[660, 1050] it is the most common variety of sarcoma encountered in this region. Chalier and Bonnet[207] have estimated that from two to three per cent of all melanomas of the gastro-intestinal tract occur in this region. Daland and Holmes[262] found their incidence to be 1.7 per cent in their series of 174 cases. Weeks[1030] stated that pigmented melanosarcoma is twice as frequent as the nonpigmented variety. Several large series of malignant melanomas have been reported by Adair,[3] Spiese[950] and Cholnoky[216] without mentioning a single case of the anorectum. Malignant melanoma is considered the most malignant variety of tumor encountered in this region.[964]

A melanotic tumor occurring in man was probably first described by Laennec,[580] in 1806, while Moore,[731] in 1857, reported a case involving the rectum. Virchow[1011] cited two cases, one of his own and another by Maier; he recognized both sarcomatous and carcinomatous varieties. Paneth[778] discussed melanosarcoma of the rectum and collected eight cases from the literature in addition to one of his own. Wiener[1070] reported a postmortem examination in which all the structures were involved. He mentioned that Drenkhanh and Esmarch reported two cases, although no histologic findings were described. Chalier and Bonnet reviewed the literature and compiled the first comprehensive report covering 64 authentic cases and eight doubtful ones, which they were not able to follow. Churchman[219] reported one of his own. Additional cases have been reported.[13, 65, 215, 391, 394, 409, 411, 467, 491, 527, 561, 608, 697, 981, 1058, 1091]

Origin. Malignant melanomas are considered to arise in the anal canal and gradually invade the rectal mucosa.[207] Smith and Broders[946] employ the term "melanoepithelioma" when they arise in the anal skin. One case reported by Kallet and Saltzstein[527] developed in a rectal polyp. These tumors, *seldom multiple*,[220, 668, 920, 995] may be sessile or pedunculated and vary in size, at times approaching proportions huge enough to cause obstruction. Usually they are irregular in shape, rough and dark brown or black in color, owing to the pigment melanin. About one third of these growths disclose scant melanin or entire absence, but the metastases are always deep black in color and contain large amounts of pigment. Tumors located in the anal canal are characterized by severe pain; ulceration is common and metastasis may occur early by way of the blood stream or lymphatics. They metastasize early to the inguinal nodes, while a similar lesion of the

was performed, and tissue examination of the removed specimen confirmed both diagnoses. Two years later, he returned with recurrence and died shortly thereafter. As to surgical management, the removal of both lesions is recommended. At times, a stage maneuver may be employed.



FIG. 480. (*Left*) G. J., 3 years, 9 months. (*Right.*) A low-magnification microphotograph of the tumor showing the uniformity of the cell morphology, the fusiform appearance of the cells and the areas of myxomatous degeneration. (Bacon, H. E., and Sealy, W.: Am. J. Surg. 45:339.)

Infantilism. An unusual case was reported by Ricketts[870] in which carcinoma of the colon, chronic ulcerative colitis and infantilism occurred in a male 18 years of age. Additional instances of infantilism have been recorded.[166, 181, 279, 345, 361]

Leukemia. Instances of leukemia associated with malignancy have been reported,[738] although such a case has not been encountered in the author's experience.

Mortality and Survival Rates. It is customary to conclude the discussion of malignancy with a general over-all picture, but such has been deleted here, since the rates of both mortality and survival have been appended to the various technics employed.

CONNECTIVE TISSUE TUMORS

SARCOMA

A sarcoma is a malignant tumor derived from connective tissue. Compared to carcinoma, it is of infrequent occurrence and, according to Weeks, represents approximately 1 per cent of all malignant growths of the anorectal region. In our series of cases from Group C, the incidence is estimated at 3.1 per cent, whereas in Group A, eight of the 800 cases were sarcomas, or 1 per cent. Sarcoma may occur at any age, although the incidence is earlier than in carcinoma. Goodman[412] reported a case at four years and the author[70] another at four years and seven months. According to sex, these tumors are about evenly distributed.[517] In Group C, 20 were males and 18 females, while in Group A, five were males and three were females.

TYPE	NO.	MALES	FEMALES
Malignant melanoma	2	2	0
Fibrosarcoma	3	2	1
Leiomyosarcoma	2	1	1
Neurogenic sarcoma	1	0	1
Total	8	5	3

Pathology. Sarcomata may be located in the anus, rectum or sigmoid colon, although they are more common in the lowermost portion of the last. (Fig. 480.) These tumors are highly malignant and very vas-

hard nor nodular. Several pea-size elevations of purplish color appeared beneath the surface of the skin. The process was distinctly tender to the touch; the edges were reddened. No fluctuation was noted. The sphincter muscle was irritable. Proctosigmoidoscopy was negative. There was no inguinal adenopathy. General physical examination was distinctly negative; roentgenographic study of the chest disclosed no metastasis. The patient was admitted to Temple University Hospital and under lumbar analgesia the melanotic process was excised widely. A nodule appeared in the right groin three days following operation. It was hard and nontender; two smaller nodules later developed in the femoral triangle.

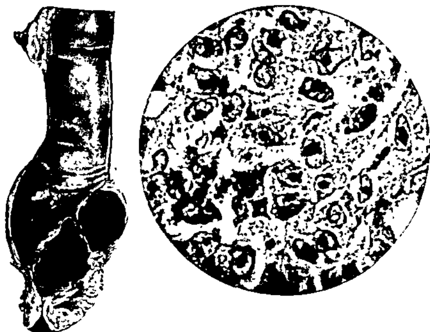


Fig. 481. (*Left*) Melanoma of the rectum. (Q. Wood and H. Lindner: Brit. J. Surg. July, 1936.) (*Right*) Photomicrograph (× 900). Tumor cells with melanin granules. (H. H. Lindner.)

Section through the tumor showed thinning of the overlying epidermis, an area of superficial ulceration and foreign body reaction. The neoplastic cells for the most part had a septate alveolar and pseudo-acinar arrangement. In many areas, neoplastic cells could be seen within the lumina of endothelial lined spaces. The neoplastic cells were collected in large nests and nodules. They were deeply pigmented. Conclusion: Malignant melanoma of anus.

A groin dissection with implantation of 25 gold radon seeds, 1.5 mc. each, was performed on December 4, 1942. Subsequent examination of the anorectum revealed a cluster of bluish nodules in the anterolateral portion of the right ischiorectal fossa. On proctoscopy, a solitary bluish nodule was found involving the mucosa at a distance of 5 cm. Under lumbar analgesia, the area of recurrence was widely excised by means of the surgical diathermy. The excision included the anal canal and external sphincter muscle on the one side. The ischiorectal fat was removed together with the lateral wall of the rectum. Ten gold radon seeds, 1.5 mc. each, were distributed throughout the operation area. The postoperative course was uneventful and he was discharged to his home one week later. One month later he was confined to bed, with marked abdominal swelling, free fluid in the abdomen and the liver markedly enlarged. He died on January 13, 1943.

Case 2. A salesman, aged 61, was referred because of rectal pain and diarrhea. The pain had been present for a period of four weeks, was dull in character and aggravated by defecation. A frequent desire to defecate was experienced. No bleeding was noted. He had lost some ten pounds in weight during this period. Sigmoidoscopic examination (27 cm.) revealed a firm, irregular mass, involving the lateral rectal wall, at a distance of 7 cm. above the anal margin and measuring approximately 2 × 3 cm.

The patient was admitted to Temple Uni-

rectum metastasizes usually to the liver and lungs. Local recurrence is frequent and metastasis has been seen in every case.

Chemical Structure. The chemical structure of melanin is not known but it is considered to be a nitrogenous compound closely related to proteins; containing sulfur yet iron-free. It has been observed that different compounds bear the general name of melanin. Normally it can be found in the human body; in the retina, choroid, meninges, hair follicles and skin. It is commonly agreed to be a metabolic nucleolar product. Tomahlen[991] observed that the urine of a patient with malignant melanoma became black on exposure to the air and suggested that it was a product of oxidation of cellular secretion. Quatlini[824] was able to produce pigmentation by injection of indole and skatole and deduced that some substance similar to the indoles was a chromatogenic substance which was acted upon by a ferment in the tissues to produce the pigment. Block[136] extracted from the broad beans a substance that he believes to be three-four dihydroxyphenylalanine (Dopa), that is oxidized by a tissue ferment giving origin to melanin. He states that this ferment is present in the melanoblasts that are modified basal cells. He believes that some substance closely related to Dopa is present in the blood plasma that is oxidized by this cellular ferment to form melanin.

Histogenesis. The histogenesis of malignant melanoma and of the benign form, the nevus, has been controversial. Una[1005] believes that they arise from the stellate cells, melanoblasts or Langerhans cells of the basal layer of the epidermis, thus considering all melanomas as carcinomas. Masson[671] attempted to prove that the original melanotic cell is of mesoblastic or neuroectodermal origin and not from epithelial sources. Others concur more or less with this view.[13, 854, 940] Ewing[327, 330] supports strongly Ribbert's[866] theory that they originate from the chromatophore, specific mesoblastic cell. In 1925, Masson[671] was able to demonstrate, by means of special staining methods, that between cells of a nevus there is an abundance of fine nonmyelinized nerve fibrils. In the dermis, the myelinated nerve fibers terminate in Meissner's corpuscles, from which unmyelinized fibrils pass into the epidermis and end in the tactile corpuscles of Merckel-Ranvier. Both of these corpuscles are formed of specialized cells. Associated with them are chromatophores. According to his studies, a melanoma is only a proliferation of the entire end organ, which in the dermis is represented by Meissner's corpuscles, plus chromatophores, and in the epidermis by the corpuscles of Merckel-Ranvier together with chromatophores. Masson's theory was thoroughly confirmed by Foot.[358] Laidlow[587] and Murray reported the studies of sections from the pigmented tactile spots of the alligator and noted the striking resemblance in every detail to the nevus. Dupont,[312] after studying a number of malignant melanomas, states that Masson's studies in benign melanomas, or nevus, cannot be applied in the great majority of malignant cases, but in some it is possible to trace the nervous origin.

Two cases admitted to our service are reported herewith:

Case 1. A retired manufacturer, aged seventy-two, was referred in November, 1942, because of a hemorrhoidal mass at the margin of the anus. The patient stated that in July, 1942, because of "insufficient space in rectum," he consulted a physician who performed an operation, ostensibly for hemorrhoids. Because of the passage of "blood clots," he returned for a second operation. Subsequently, discomfort at the time of bowel movement was experienced. The movements were regular, complete and satisfactory. The hemorrhoids, he contended, were still present. He had lost 25 pounds in weight since the onset. Of interest in the history is that his mother and uncle died of cancer of the rectum and an aunt died of malignancy of the breast.

Examination disclosed a healed scar in the right posterolateral phase of the perianal skin. Involving the skin and subcutaneous tissue of the right anterolateral quadrant was a rounded mass, regular in outline, approximately the size of a half dollar. It was firm but neither



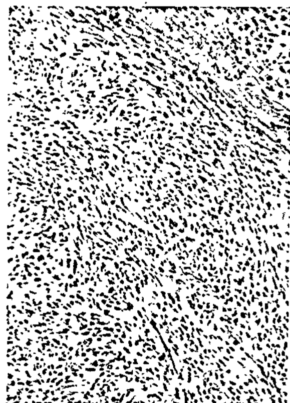


FIG. 483. M. F., age 57. (*Left*) Fibrosarcoma of rectum. Specimen removed by abdominoperineal proctosigmoidectomy. Patient living and no recurrence 31 months following resection. (*Right*) Fibrosarcoma. The tumor is quite cellular. It is composed of interlacing bundles and whorls of spindle cells, which in some areas appear to be producing collagen. Interrupting the solidity of the tumor are small wedges and absorptive trabeculae of hyalinized connective tissue and masses of myxomatous tissue. There is one area of necrosis. The neoplastic cells vary little in staining quality, in size and in shape, although the nuclei are swollen and stubby and occasionally form giant cells.

was intact and the mass seemed to be impinging on the rectum from the posterior aspect. Pressure over the coccyx and over the mass produced severe pain. Proctoscopy confirmed the fact that the mass originated beneath the mucosa. It was impossible to reach beyond the growth with a sigmoidoscope. A biopsy was taken from the mass which was reported "fibrosarcoma." X-ray studies of the colon and rectum demonstrated marked displacement of the rectum in an anterior and left lateral plane by a large extrinsic tumor that lay in part of the hollow of the sacrum.

The patient was adequately prepared for surgery and on May 23, 1946, an abdominoperineal proctosigmoidectomy without colostomy and with wide excision of the mass was performed by the author. The mass was apparently removed in its entirety. Rather profuse hemorrhage was encountered from the presacral area which necessitated gelfoam and a large pack for hemostasis. The postoperative course was uneventful and on June 8, 1946, the patient was discharged from the hospital, on the fifteenth postoperative day.

Her progress since discharge has been extremely satisfactory. She has gained weight, and when last seen in December, 1948, her bowel was functioning well and there was no evidence of recurrence.

LYMPHOSARCOMA.[574] Lymphosarcoma, or small round-cell sarcoma,[696] is a highly malignant tumor having its origin in the lymphoid tissue, which, according to Ewing,[323] results from proliferation of atypical lymphocytes. As a rule it begins insidiously as a localized thickening of the submucosa, but later grows rapidly. It infiltrates the

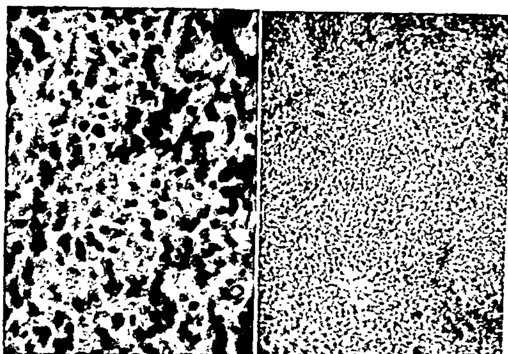


FIG. 482. (*Left*) Photomicrograph of fibrosarcoma of rectum showing an infiltration of spindle-shaped cells with the characteristics of malignancy. Note the bizarre arrangement of cells and numerous mitotic figures. (*Right*) Photomicrograph, high power, of fibrosarcoma of the rectum showing diffuse infiltration of rapidly growing malignant cells.

versity Hospital and, under lumbar analgesia, a proctectomy was performed and radon seeds implanted locally. Microscopic examination revealed malignant melanoma. The patient progressed in an uneventful fashion and was discharged three weeks following operation. The patient continued to gain weight. His appetite was good and he returned to light work. Eleven months later, he returned, complaining of pain in the thorax. Roentgenographic examination revealed widespread metastasis. The liver was markedly enlarged and nodular. Free fluid was present in the abdomen; skin nodules were noted in the perianal skin. The man died at his home nine weeks later.

FIBROSARCOMA. Fibrosarcoma, or spindle-cell sarcoma, is characterized by varying amounts of fibrous tissue. (Fig. 482.) The typical cell is the fibroblast. Ordinarily this type of tumor is sessile, hard, often nodular and more or less circumscribed. It may assume huge proportions and at times completely obliterates the rectal lumen.

A patient with fibrosarcoma of the rectum extirpated by the technic of "abdomino-perineal proctosigmoidectomy" is reported as follows:

Case (T.U.H. 2802 M), Mrs. M. F., a white female, age 57, was seen in consultation May 11, 1946. She complained of rectal pain which had become more severe during the previous two weeks. During the past winter the patient had experienced low sacral pain. Alternating diarrhea and constipation were cited. No blood had been observed at any time. A loss of 15 pounds in weight during the last six months period was noted. Family history revealed no incidence of malignant disease. The patient had two previous operations: a cholecystectomy, in 1932, and an ovarian operation in 1915.

Physical examination revealed a well-developed white female who had suffered evident weight loss and who appeared to be in severe and constant pain. Abdominal examination disclosed an upper right rectus and low midline scar; the liver was not felt. Deep pressure over the left lower quadrant gave one the impression of a mass being present. Above the anorectal line and posteriorly the examining finger encountered a hard, nodular, firm mass approximately 9 cm. in diameter. The mucosa



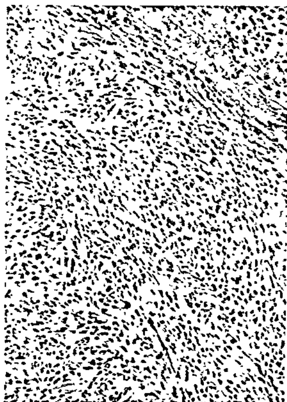


FIG. 483. M. F., age 57. (*Left*) Fibrosarcoma of rectum. Specimen removed by abdominoperineal proctosigmoidectomy. Patient living and no recurrence 31 months following resection. (*Right*) Fibrosarcoma. The tumor is quite cellular. It is composed of interlacing bundles and whorls of spindle cells, which in some areas appear to be producing collagen. Interrupting the solidity of the tumor are small wedges and absorptive trabeculae of hyalinized connective tissue and masses of myxomatous tissue. There is one area of necrosis. The neoplastic cells vary little in staining quality, in size and in shape. although the nuclei are swollen and stubby and occasionally form giant cells.

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The patient was adequately prepared for surgery and on May 23, 1946, an abdominoperineal proctosigmoidectomy without colostomy and with wide excision of the mass was performed by the author. The mass was apparently removed in its entirety. Rather profuse hemorrhage was encountered from the presacral area which necessitated gelfoam and a large pack for hemostasis. The postoperative course was uneventful and on June 8, 1946, the patient was discharged from the hospital, on the fifteenth postoperative day.

Her progress since discharge has been extremely satisfactory. She has gained weight, and when last seen in December, 1948, her bowel was functioning well and there was no evidence of recurrence.

LYMPHOSARCOMA.[574] Lymphosarcoma, or small round-cell sarcoma,[696] is a highly malignant tumor having its origin in the lymphoid tissue, which, according to Ewing,[328] results from proliferation of atypical lymphocytes. As a rule it begins insidiously as a localized thickening of the submucosa, but later grows rapidly. It infiltrates the



Fig. 484. A. H., age 35. Sessile process, nodular; lymphosarcoma. Abdominoperineal proctosigmoidectomy.

surrounding tissues and causes widespread metastasis. That blood stream *metastasis* occurs only after the muscle wall of the rectum has become completely penetrated by the tumor has been postulated.[425] Although it usually occurs singly, the presence of multiple growths has been reported. Lymphosarcomata may be either primary or secondary to lymphatic involvement elsewhere. Although these tumors vary in consistency, they are usually smooth, hard and lobulated. Ulceration does not occur early.[945] *Classification and interrelative* phases of the various types is still a controversial subject, but the close relation between the various manifestations of lymphocytic neoplasia and its precursors seems to be quite well established. Whether accompanying blood changes are present or not, histologic examination has failed to predict its occurrence in lymph node involvement of the so-called lymphocytoma, lymphoblastoma or lymphosarcomatous type, although certain pathologists have advanced the theory that lymphatic leukemia, aleukemic lymphatic leukemia, lymphoblastoma or cytoma, reticulum-cell sarcoma and lymphosarcoma are variants of the same *fundamental* neoplasm. Regardless of this interrelative condition, a malignant lymphoid tissue tumor may definitely appear as an original focus and may remain temporarily local, ultimately invading and *metastasizing in a manner closely resembling* carcinoma. Several case reports are to be found in the literature.[64, 67, 257, 417, 478, 555, 593, 847, 973, 975, 990, 1004, 1006, 1035]

An interesting case of this type of tumor is reported as follows:

A. H., male, age 35: was seen in consultation January, 1947. Only complaint, bleeding per rectum. Other history, past and family irrelevant. Examination disclosed a small nodular growth in the rectum. Base sessile; mucosa intact but invaded. Pathology: lymphosarcoma. Extensive x-ray studies, repeated blood counts and sternal biopsy were reported negative. Abdominoperineal proctosigmoidectomy performed. Ileus developed postoperatively which responded to intestinal *intubation: patient discharged on the sixteenth* postoperative day. When the patient was last examined in December, 1948, there was no evidence of recurrence.

Leiomyosarcoma. This type of malignancy should be included in any discussion of the histologic types of sarcoma encountered in the anorectal region. Buie,[173] Scheffler and the author,[67] reported one case of this type of malignant growth. Of 28 leiomyomas and leiomyosarcomas collected by Geschickter,[394] only one was found to have originated in the rectum. The tumor originates from smooth muscle in the bowel

wall; its clinical characteristics follow those of sarcoma, in general. An illustrative case is reported:

G. R., a male, aged 47 years, was seen in the Proctologic Department of the Cooper Hospital Out-Patient Clinic by Doctor Scheffler in January, 1941, because of a small subcutaneous abscess in the perianal region. The patient stated that, for the past six months, he had experienced intermittent discomfort in the rectum, which had been markedly accentuated for a period of six weeks. The pain was described as "stabbing" in character and constant. No bleeding or protrusion was cited. His bowel habit was complete and satisfactory; he had had no early morning diarrhea or urgency or frequent desire for stool. The past and family history was irrelevant. Examination disclosed the presence of a tumor process in the left ischiorectal fossa. The mucosa of the rectum and the perianal skin were freely movable, although the entire left phase of the anal canal was involved by a hard, nodular mass the size of a lemon. It appeared quite distinct and separate from the prostate. Overlying the growth, the skin was indurated and a minute opening was present, which, on pressure adjacently, permitted the escape of a cystic puruloid material. The biopsy report by Dr. W. Read of Cooper Hospital read: "Leiomyoma with beginning sarcomatous change." Roentgenographic study of the lungs, long bones, vertebrae, and pelvis showed no evidence of metastasis. The patient was seen in consultation on February 20, 1941, and admitted thereafter to Temple University Hospital on the service of the author. An opinion was requested of the Therapy Department; Dr. Blady stated, "I do not feel that this case is suitable for irradiation, but believe that surgical excision should be carried out." On February 28, 1941, a preliminary doubled colostomy was performed.

On March 10, 1941, under spinal analgesia, a modified Cunéo, Sénèque, Zagdoun type of extirpation was performed.

The biopsy report read: "Gross description: The specimen is a tumor mass 10 × 4.5 × 5 cm. The tumor is well encapsulated and firm. One surface is covered by skin. On cut section, it shows a trabeculated yellow surface with areas of degeneration. Microscopic description: The tumor is quite cellular and is made up of spindled cells which have a haphazard arrangement. There is whorl formation and attempt at what appears to be palisading. The cells are spindled and fairly uniform in size, shape and staining quality. There is degeneration, necrosis, hemorrhage, and infection. The tumor apparently arises in the muscular coat of the bowel wall, and has invaded the overlying and underlying tissues."



Fig. 485. G. R., age 47. Leiomyosarcoma of the rectum. (Bacon, H. E., and Scheffler, W. A.: Tr. Am. Proc. Soc., 43:255.)

Special stains revealed that many of the tumor cells were of muscle origin, and a diagnosis of leiomyosarcoma was submitted.

The patient progressed in an uneventful fashion and was discharged from the hospital on the twenty-second day after the first stage, or the seventeenth day after the second stage of the operation. He was seen at weekly intervals and progressed well; he was free of discomfort and weighed 176½ pounds, 3½ pounds below his weight prior to admission. It was the consensus of the pathologists, radiologists, and ourselves that, if this patient continued to progress in a satisfactory manner for from nine to twelve months, a revision of the colostomy would be performed, thereby establishing the normal continuity of the bowel.

X-ray pictures taken on May 13, 1941, likewise showed no metastasis.

The patient was symptom-free, had returned to work with excellent sphincteric control, but insisted that the colostomy be closed. For this reason the continuity of the bowel was reestablished by the intraperitoneal route on September 30, 1941. He passed formed stools with almost complete continence at the time of his discharge eighteen days later. He remained symptom-free until the onset of an acute intestinal obstruction, for which reason an enterostomy was performed under local anal-

gesia. Ten days later adhesions knuckling the bowel were freed. Two Babcock alloy drains were introduced and the abdomen closed with wire. The patient was discharged December 23, 1941. Subsequently the ileostomy closed almost completely.

When examined in March, 1942, recurrence of the tumor was palpated by rectum. He died within a period of six months.

Reticulo-Endothelial Sarcoma. Instances of reticulo-endothelial sarcoma are extremely rare, especially in a child under four years of age. An illustrative case under our care several years ago is described:

G. J., a white boy, age 3 years 8 months, was admitted to the urologic service, St. Luke's and Children's Hospital, on August 19, 1938, because of acute urinary retention and constipation. According to the parents, the child was well until the previous month, when constipation suddenly became severe. The past and the family history were irrelevant. On two successive days prior to the child's admission catheterization was resorted to. Physical examination disclosed a child well nourished but in a state of apparent distress. The abdomen was distended, and the bladder was noted three fingerbreadths above the symphysis pubis. By rectum, a dense globular mass, presumably bladder, was palpated, for which a provisional diagnosis of distended bladder caused by a stricture or a vesical calculus was made.

Examination of the urine showed a specific gravity of 1.028 and an acid reaction. There were a trace of albumen, no sugar, some amorphous urate crystals, threads of mucus and a few epithelial and yeast cells. Culture of catheterized specimen showed staphylococci. The blood count was: red cells, 4,750,000; hemoglobin 85 per cent, white cells, 17,600, polymorphonuclears 70 per cent, lymphocytes 30 per cent. Mantoux, Wassermann and Kahn reactions were negative. Intravenous urogram showed nothing abnormal except a mild hydronephrosis on the right side, with mild blunting of the papillae, increase in the size of the left calyx and increase in width of the right ureter.

Rectal examination showed the sphincter muscles to be definitely atonic. A mass approximating one half the size of an adult head, causing encroachment on the rectum almost to include the rectal lumen, was palpable. The mass, which appeared to be encapsulated and adherent in all phases, was found to involve the pelvirectal, prerectal and retrorectal spaces. An attempt was made to remove the growth in its entirety.

The histologic diagnosis was: recticulo-endothelial-cell sarcoma. The patient received a series of ten treatments with heavily filtered radiation. One hundred and fifty roentgens were delivered at each sitting through a 20 by 20 cm. portal.

Roentgen examination of the bones revealed nothing significant. The size of the mass rapidly receded, and the child gained appreciable weight and improved generally. Three months later, a nodule was palpable in the rectal wall, which slowly increased in size, irrespective of the roentgen therapy instituted. Finally a course of refrigeration was administered, which was complicated by measles and bronchial pneumonia.

The patient died May 12, 1940, at the age of 5 years 3 months. Autopsy disclosed a reticulum-cell sarcoma of the rectal wall with extensive pulmonary metastases. The tumor was purplish red and soft and was found to compress the left ureter, as well as the sigmoid flexure of the colon.

Another rare type of sarcoma is neuromyxofibrosarcoma, reported by Mentzer.[706] In our series, there was one instance of neurogenic sarcoma. (See Fig. 486.)

General Symptomatology. The symptoms are usually most indefinite. In fact, it may be said that there are no distinguishable symptoms of anorectal and sigmoidal sarcomata. Ordinarily, bleeding, rapid cachexia, loss of weight over a short period of time, increasing weakness and discomfort or fullness in the rectum are constant features. Diarrhea or constipation is a not infrequent complaint. The pain, which occurs earlier and is more marked than in carcinoma, is often agonizing, especially where the growth involves the sphincter or bears pressure on structures innervated with sensory nerves. It exists independently of defecation, although the intensity of the pain is usually enhanced by the action of the bowels. According to the location of the growth, the pain may be referred to the bladder, sacrum or thigh. Symptoms referable to the upper gastro-intestinal tract are

not uncommon. Sooner or later the patient complains of a foul discharge — blood, mucus and pus—which denotes that ulceration has taken place. An anal growth and one protruding through the orifice causes the patient to seek medical advice early.

lymphosarcoma by the sensation as a "velvety mass pressing upon the lumen of the bowel."[1014]

To stress the difficulty in diagnosing lymphosarcoma, which is also true of fibrosarcoma, Smith[945] sums up as follows:

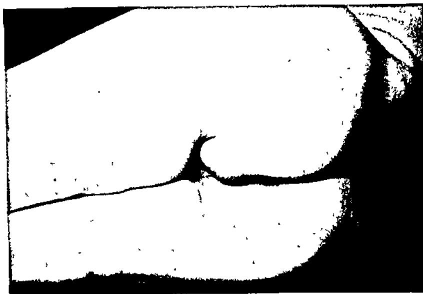


Fig. 486. F. D., age 58. Neurogenic sarcoma.

Diagnosis. The diagnosis of sarcoma is seldom made except by biopsy, operation or necropsy. If one examines a case in its incipiency, it is noted as one or more nodules which appear to arise from the substance of the rectal wall and over which the mucosa is movable. Later, as the tumor increases in size and becomes fixed, it feels tender, hard and smooth, although it may be nodular. As ulceration occurs, the growth is less hard, frequently soft and almost spongy to the touch. It will be helpful to remember that a sarcoma usually gives the impression of a mass encroaching on the rectal wall, rather than arising in the superficial mucous membrane. Such does not mean that all sarcomata are sessile and confined to the wall, because polypoid growths are encountered occasionally. Pigmented tumors should always arouse a suspicion of malignant melanoma; fibrosarcoma by its hardness and nodularity, and

"Digital examination of the rectum frequently will reveal the presence of one or more tumors, but with such variation is this type of growth manifested in the gross appearance, that very little information of differential significance can be obtained by this alone. Sigmoidoscopic examination serves but to add confusion."

Differential Diagnosis. There are several pathological entities that should be differentiated from rectal sarcoma. Chief among these are carcinoma, benign adenoma, syphilitic gumma, thrombosed, ulcerated hemorrhoids, eleoma or chemical tumors and actinomycosis. The distinguishing features are shown on page 672.

Prognosis. Due to early and rapid metastasis, the tendency to recurrence and the early age at which it occurs, sarcoma presents an exceedingly grave prognosis; in fact, the termination is fatal. Few cases are reported in the literature in which the pa-

tient is living beyond two years. Kallet[227] cited a case symptom-free for four years, death ensuing in the fifth year from cerebral metastasis; Harris[117] also mentions a case of rectal polyp undergoing sarcomatous change with a five-year survival.

Treatment of Sarcoma. Early and radical surgery is indicated, to be followed by irradiation in the incipient stage. For those that are deemed inoperable, radiotherapy alone may be instituted. According to Binkley,[121] radiation therapy is the method of choice, provided that the tumor is radiosensitive.

The results in Group A are tabulated below with two additional cases.

TABLE 68
(Author's Series)

NAME	AGE	SEX	TYPE	TREATMENT	DURATION OF LIFE FOLLOWING EXTIRPATION
J. W.	72	M	Malignant melanoma	E*	6 months
A. B.	61	M	Malignant melanoma	E	1 year and 1 month
M. F.	57	F	Fibrosarcoma	E	Still living and free of recurrence 2 years 7 months after operation
F. G.	64	F	Fibrosarcoma	E-I	Not followed
C. E.	69	F	Fibrosarcoma	E-I	3 years and 8 months
F. D.	58	F	Neurogenic sarcoma	E	1 year and 8 months
G. R.	47	M	Leiomyosarcoma	E-I	1 year and 6 months
F. L.	51	M	Leiomyosarcoma	E	Known to have lived 2 years plus
G. J.	3 yrs. and 8 mo.	M	Reticulo-endothelial sarcoma	E-I-R	1 year and 4 months
A. H.	35	M	Lymphosarcoma	E	Operated upon March, 1947. No recurrence as of December, 1948

* Key:
E—extirpation
I—irradiation
R—refrigeration

CHAPTER 19—PART 3

Treatment of Malignant Tumors

SURGICAL TREATMENT—(Cont.)

PERINEO-ABDOMINAL EXCISION—PERMANENT COLOSTOMY (GABRIEL)

PERINEAL EXCISION—WITH OR WITHOUT PRESERVATION OF SPHINCTERS (YEOMANS)

LOCAL OR PARTIAL EXCISION (BEVAN)

ABDOMINAL RESECTION — SIGMOIDECTOMY

A. SIGMOIDECTOMY — DELAYED CLOSURE (MIKULICZ): DESCRIPTION, TECHNIC; EXTRAPERITONEAL AND INTRAPERITONEAL CLOSURE

SIGMOIDECTOMY — DELAYED CLOSURE (RANKIN MODIFICATION): ADVANTAGES, TECHNIC, MORTALITY AND SURVIVAL RATES; OF BOTH MIKULICZ AND RANKIN METHODS

SURGICAL TREATMENT—(*Cont.*)

B. SIGMOIDECTOMY — IMMEDIATE CLOSURE DISCUSSION, *TECHNIC OF CLOSED AND* OPEN METHODS

C. RECTOSIGMOIDECTOMY

CLOSED METHOD (WANGENSTEEN)

OPEN METHOD (DIXON)

MORTALITY OF OPEN AND CLOSED METHODS; SURGICAL DECOMPRESSION, *COMPLICATIONS, LOCAL RECURRENCE,* SURVIVAL RATES

D. SIGMOIDECTOMY OR RECTOSIGMOIDECTOMY WITH PERMANENT ABDOMINAL COLOSTOMY (HARTMANN), TECHNIC, MORTALITY RATES, SURVIVAL, EVALUATION

COMPLICATIONS AND SEQUELAE

MORTALITY: CAUSE OF DEATH

SUMMARY

It is difficult to draw sharp lines of demarcation in considering the various methods employed in the treatment of malignancy of the anus, rectum or sigmoid colon, inasmuch as there is necessarily some degree of overlapping because of the combined procedures. For the purpose of description the treatment may be divided into nonsurgical and surgical, each of which is subdivided as follows:

- I Nonsurgical (Palliative)
  - A. General
  - B. Colloidal metals
  - C. Carbon dioxide snow
  - D Electrotherapy
    - Surgical diathermy
    - Endosection
  - E Irradiation
    - Roentgen ray
    - Radium
- II. Surgical
  - A Colostomy (see Chap 20)
  - B. Radical
    - Perineal
    - Abdominoperineal
    - Abdominal
  - C. Partial excision

NONSURGICAL TREATMENT

General

Fresh air, sunshine, hygienic measures and pleasant environment are all of some efficacy in dealing with this dread malady. The diet should be of high caloric value, wholesome, liberal, consisting of those foods which leave but little residue, especially strained gruels, cooked fruits, eggs, milk, cream soups, creamed vegetables, beef, chicken and liver. Water should be taken freely to prevent dehydration. Prevention of fecal accumulations is essential.

Drugs. For evacuation of the bowel, liquid petrolatum, from ½ to 1 ounce, once or twice daily is usually sufficient to cause soft evacuations. This may be adjusted to the character of the stool. *Irrigations of potassium permanganate 1:10,000 at 110° F.*

daily will diminish the mucopurulent discharge. This may be supported by the instillation of from 10 to 20 cc. of ichthyol (25% aq. sol.). In order to strengthen the patient, tonics of iron, liver, quinine, strychnine, vitamins and hydrochloric acid are of value. Where patients are being prepared for operation, there is no better method than one or more blood transfusions. For insomnia, salts of bromide or one of the barbiturates are effective. Where pain is moderate, codeine sulfate, gr. ¼ to ½, or Demerol 50 mg., is usually sufficient; but in late, inoperable cases, morphine sulfate, gr. ¼ or in sufficient doses to alleviate the suffering, may be indicated.

Colloidal Metals

Various metallic substances in a colloidal state have been advocated in the treatment of inoperable cancer. Buie[170] employed lead phosphate and lead selenium in a series of cases with improvement in some and apparent regression of the tumor in a few. He is of the opinion that in conjunction with surgery and irradiation this form of treatment may prove helpful in a small group of cases. Bell[90] reported good results from the use of a colloidal suspension of metallic lead. Lockhart-Mummery considers this procedure decidedly dangerous, as may be deduced from the report of Martland.[649] Colloidal copper, however, according to Lockhart-Mummery,[622] prolongs life and diminishes the discharge. He injects from 3 to 5 cc. deep into the glutei muscles once or twice weekly for a period of four months. This is followed by a rest for one month, at the end of which time the course is repeated. Colloidal gold, suspended in pure water, is advocated by Ochsner.[765] In one case of rectal cancer he obtained a temporary improvement by the injection of the solution into the lower colostomy opening.

It must be admitted that the employment of these colloidal substances is in the experimental stage, and, even though some improvement may be obtained in an occasional instance, in the light of our present knowledge their use should be limited to inoperable cases in which irradiation is contraindicated or has proved of little value. In cases where these colloidal substances are employed, the patients should be closely watched for signs of intolerance.

Carbon Dioxide Snow

As a palliative procedure in inoperable cases, Clemons[2-5] advocates the extraction of heat by means of carbon dioxide snow.

Technic. The snow resulting from liberation of liquid carbon dioxide contained in a tank is collected in a chamois and packed tightly in thick rubber finger cots. A mushroom catheter is inserted into the cot and a piece of string is tied around the latter to prevent escape of the snow. It is then lubricated with petroleum jelly and introduced into the anal canal until it comes in contact with the growth. According to Clemons, the congealed petrolatum adheres to the rectal mucosa and heat is extracted. The free end of the catheter is submerged in a small container of water, in which the heat escaping from the rectum causes bubbles. As soon as these bubbles cease, another cot packed with the snow is similarly inserted. This process is repeated for a period of from two to three hours. A second treatment of shorter duration is administered at the end of the first week. Following an interval of six weeks, two similar treatments, one week apart, are given. This author claims that in patients treated over a period of six months shrinkage of the tumor was noted. He further states that patients thus treated should all increase in weight and strength.

Electrotherapy

Electrocoagulation or Biterminal Surgical Diathermy. As previously mentioned under Hemorrhoids (Chap. 16), abnormal tissue may be destroyed by through-and-through heat, the degree of which must be sufficient to coagulate the tissue proteins. According to Kolischer,[559] a mechanical destruction of the growth is produced, and additionally, there occurs a release into the circulation of certain substances and antibodies tending to inhibit further progress of the disease. Applied to cancer of the

rectum, this method may be used for very small, sessile and pedunculated growths located well below the peritoneal reflection.[218] The reaction, according to Campbell,[190] may possibly be attributed to an intense stimulation of the reticulo-endothelial system and also the consequent local and general phagocytic action of the macrophages. As to whether surgical diathermy inhibits the further progress of pathologic spread along the lymphatics or in distant organs such as the liver, such a phenomenon is more or less hypothetical. For growths that are deemed inoperable due to fixation, metastasis, old age or constitutional disease, surgical diathermy may be employed. Kolischer found it exceedingly useful in the inoperable and recurrent type of rectal carcinoma, due to its action in causing cessation of pain, bleeding and discharge. However, if the lesion is above the peritoneal reflection, destruction of tissue may result in perforation and a subsequent peritonitis. It is also to be kept in mind that, following the procedure, stenosis is apt to occur. Strauss[966] therefore called attention to the formation of excessive scar tissue as a result of too deep a grade of destruction, stating that infections in the pararectal spaces may also supervene.

Christianson[218] believes that where the growth is located on the anterior or lateral surfaces, there is always danger of burning through the bowel wall and into other important structures.

Technic. A proctoscope of suitable length made of glass or bakelite is introduced into the rectum, and the lesion exposed; in each case visualization is essential. The needle electrode is inserted into the depth of the growth and the current turned on until bubbling appears or the tissue immediately surrounding the needle becomes grayish-white. The procedure is repeated until the growth is destroyed in its entirety. Where tumors are polypoid, they are grasped with long forceps and the electric snare is placed at the base of the pedicle. Whenever feasible, all tumor tissue is to be destroyed at one sitting. Ordinarily, it is advisable to confine the patient to bed for a day or so, although many prefer the ambulant method. Hemorrhage and sloughing of the normal mucosa are complications encountered occasionally. It is essential that all patients be re-examined in order to decide whether further diathermic treatment is indicated. Strauss[968] is quite enthusiastic about this method. His technic follows:

Strauss Technic. The patient is prepared by the daily administration for several days of one ounce of magnesium sulfate in several ounces of water divided into 16 doses. Enemata and irrigations of the lower bowel are given, following which the sigmoid colon and rectum are emptied by a suction apparatus. If necessary, a transfusion of 600 cc. of blood is administered. Under ether anesthesia, the sphincter muscle is stretched to admit the glass speculum, which is introduced to the site of the growth. The insulated electrode is inserted and the growth coagulated. The author mentions that superficial coagulation is best in order to avoid perisacral infection and osteomyelitis. By the same token, decidedly less stricture and scar formation results. After a period of two or three weeks, depending on the amount of tissue destruction as determined by rectal examination, the procedure is repeated. In some cases it was felt advisable to resect this scar tissue. Here, a modified Kraske procedure is performed by making an incision over the lower sacrum and coccyx and, following excision of the latter, the levator muscles are split and retracted, the rectum being cut transversely caudad and cephalad to the scar tissue. Both proximal and distal ends are then united with interrupted silk sutures and an inner layer of continuous chromic catgut sutures. Finally, the wound is closed without drainage.

Strauss employed this method in a series of 42 cases and reported 31 as appearing in excellent condition; one after seven years; two after six; seven after five; nine after four; and twelve after three years or less. Gain in weight and increase in the erythrocyte count and also the hemoglobin were noted.[967] He remarked: "The fact that 22 of them were not subjected to colostomy and have full use of the rectum makes the results compare favorably with those se-

cured by radical surgery." Fansler[310] considers electrocoagulation a valuable adjunct in combating cancer. For the larger obstructive growths he feels that the method will produce an almost revolutionary change in the operable mortality rate.

We have seen a number of cases treated by surgical diathermy, and, almost without exception, the results have been most discouraging. Conversely, we have employed it in a small series of cases where the growth, proved positive, was small, usually pedunculated but at times sessile. These patients have been checked periodically without signs of recurrence, and we have deduced, therefore, that the procedure should be reserved for early growths of small size. For the inoperable cases, electrocoagulation may be employed but the results are questionable, since our experience with the procedure is much too meager to warrant definite conclusions.

Ferguson[314] quoted Strauss as speaking of the primary fever following treatment and of the accompanying danger of cerebral hemorrhage and thrombosis. From his experience with 16 cases he formed the opinion that electrocoagulation was of value as a palliative procedure in inoperable rectal carcinoma and as a curative method in certain cases of fungating carcinoma in those patients on whom operative procedures were deemed inadvisable. The treatment, in addition to being applied through a proctoscope via the anal canal, may be administered through the lower opening of a colostomy. There is a possibility of cure in those lesions projecting into the rectum, but the cure is less effective in the ulcerated type of lesion, although in such cases it does appear to retard the growth. Carcinoma of the rectum in any given case is a serious condition, and the formation of a colostomy stoma as part of surgical procedures is, as Johnson states,[502] a disagreeable burden, especially in the aged, who are invariably unable to care for themselves under such circumstances. A carcinoma in this locality in the aged is all the more serious due to the presence of complicating factors such as coronary disease, myocardial degeneration and marked anemia with weight loss, rendering the patient perhaps unfit for a major operation. Johnson confines the use of electrocoagulation to inoperable and poor risk cases exclusively, such as the aged, whose life expectancy at best is short.

Pope[812] has made the assertion that favor is gaining in the use of electrosurgery in the treatment of early adenocarcinomata. The results obtained by the author in his cases have encouraged him to display an even more favorable outlook, and it is his belief that in properly selected cases an early adenocarcinomatous lesion in the rectosigmoid and sigmoid may also be so treated. Hayes[458] has advised that malignant polypi and lymphoid tumors, in addition to rectal carcinoma, should be similarly treated. The main and determinant factors in the use of electrocoagulation in early lesions are that they must be mainly mucosal and therefore movable and, in addition, that the muscularis is not involved, with but one exception: lesions limited or invasive in the posterior rectal musculature against the sacrum may, on occasion, be destroyed, perforation of the rectal wall in this instance being permissible because protection by the bony pelvis is possible under the circumstances. Several cases of early adenocarcinoma of the colon and rectum beyond the stage of malignant adenoma were presented in support of the author's contentions. It was proposed by the author that by reason of the clinical phenomenon resembling radium and x-ray therapy, the high frequency current probably gives beta and gamma radioactivity. In seven cases treated with varying types of electrosurgery, there have been excellent results to date; these were adenocarcinomata of the colon and one rectal type limited to the mucosal area.

In connection with the question of colostomy in these cases, especially the inoperable type, Teperson[996] agreed with others that in such cases it did alleviate an exist-

ing obstruction but did not, under any circumstances, prolong the life of the individual. Even here, however, many of these obstructive rectal growths may yield to electrocoagulation with resultant immediate relief. This author treated 26 cases in a four-year period with most gratifying results; there was no operative mortality in the series.

E. G. Martin[1119] made use of quite a different method of procedure than that ordinarily followed, in that he used an active electrode consisting of a long needle applicator which is thrust into the lesion at various sites and coagulation is then performed. The tumor is also fulgurated from the surface. Santos[698] used practically the same *technic* as that followed by Strauss, treating 35 cases in an advanced stage of malignancy without a fatality. Twenty-seven of them are living and well and of these, 13 are five-year survivals or longer.

Electric Cutting Current or Endosection. Here, a biterminal, undamped, high-frequency current is employed.[571] With this method, the "cutting" is accomplished by molecular tissue disintegration from within, rather than by the production of heat. Various terms have been applied, such as endotherm knife, Bovie knife, radio knife or acusector. In the treatment of anorectal cancer, the limits of endothermic methods must be appreciated and their *fields of* applicability reasonably regarded. Anal epitheliomata and occasionally low-lying carcinomata of the rectum may be removed by this method, but in each instance emanation seeds should be implanted prior to excision. Yeomans[739] advocates irradiation of the tumor from three to six weeks prior *to*, as well as at the time of, removal of the malignancy.

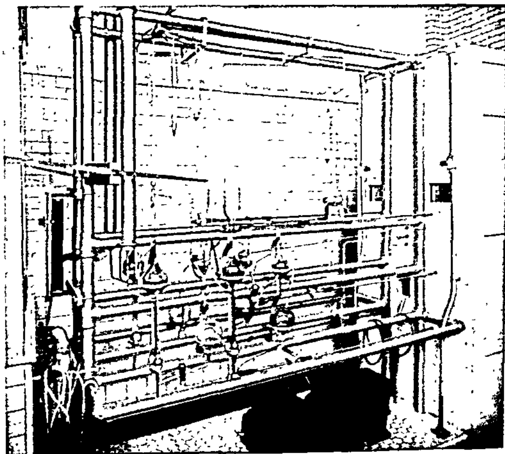


Fig. 487. Radium emanation plant. (Philadelphia General Hospital.)

Obviously, indiscriminate use of either the above procedure or of electrocoagulation or fulguration is to be guarded against, but, in certain well selected cases, these methods can be made a part of the armamentarium in combating malignancy and, although a permanent cure may not be possible, patients may benefit by amelioration of pain and the elimination of a sloughing, ulcerated carcinoma, which is of the utmost importance not alone from the individual but also from the social point of view.

Comment. In the foregoing paragraphs, electrosurgical methods have been discussed and, as is our purpose, the results obtained by various investigators cited. The author, however, is of the conviction that the applicability of such procedures is extremely limited. For inoperable cases of rectal cancer involving the posterior and/or lateral walls these methods may be attempted; in a patient whose physical condition definitely contraindicates radical surgical intervention, electrotherapy may be employed. One should not judge from our experience, because the series has not been large. The results have been exceedingly disheartening and the author is firm in his belief that cure can only be achieved by radical surgical extirpation.

Radiation Therapy

In the treatment of this disease, irradiation should be looked upon as but the handmaid of surgery, which should always be considered first for cases of cancer involving the anus, rectum and sigmoid colon.[151, 928] Experience has shown that no single method of treatment is suitable for all cases. The recent advances in the therapeutic use of radium and roentgen rays are convincing evidence that those methods are of value, especially with the improved technic, increased voltage of present-day installations and more discriminating selection of cases.

A brief description of radium and the roentgen ray may prove of interest to those not familiar with their action and applicability, although for practical purposes these two types of rays are regarded as capable of producing similar biologic effects.[1049]

Radium. Radium is an unstable metallic element. Consequently, for therapeutic purposes the rays of its various salts are utilized. Quick[830] classifies it as a local agent, representing, actually, a point source of radiant energy. On the other hand, the radon implant is the most progressive, practical development in radium therapy. Twenty-five years ago, the sole gesture toward radium as a constitutional agent was the endeavor to make use of an active deposit intravenously. Obviously, this was impractical, but it since has had an interesting relevancy to the use of radioactive isotopes, undergoing development at the present time.

The therapeutic activity of radium is due to disintegration of the radium atom, by which are produced a series of different radioactive substances which eventually give off radiations consisting of alpha, beta and gamma rays. Only the beta and gamma rays, however, are used therapeutically, the latter having the greater penetrating power. One of the first products of disintegration of the radium atom is the gas "radon" or "radium emanation."

Since radon is a gas, it may be obtained in the following way. A quantity of radium in a weak hydrochloric solution is placed in a glass apparatus from which the air is excluded. By means of mercury vacuum pumps, the radon gas, with its impurities of hydrogen and oxygen, can be transferred to a purification chamber where the hydrogen and oxygen become water vapor and the water vapor is absorbed by phosphorous pentoxide, forming phosphoric acid. The pure radon is then transferred to fine capillary tubes which have previously been exhausted of air and sealed with a small gas flame. These capillary tubes are about 14 mm. long and may be made to contain a variable quantity of radon. The unit of measurement of radium is the milligram,

whereas the practical unit of measurement of radon or emanation is the millicurie.

As far as the action of radium rays is concerned, it has been believed that normal and pathologic tissues are affected by radioactive substances, although the embryonic or immature cells are less resistant than normal cells.[187] *By the same token, the* squamous epithelium of the anus is more resistant to radiation than is the mucous membrane of the rectum and sigmoid colon. Quick (*loc. cit.*) remarked that in the bowel tract radium plays a very minor role, exception being made to the rectum. The early accessible rectal growths are the proper *ones for radium. From a technical* standpoint he found this best accomplished by the use of prolonged irradiation using the filtered implants or by daily exposures of heavily filtered radium in the specially protected Binkley applicators or both. In tumors, irradiation gives rise to congestion and obliteration of the blood vessels. Cessation of *mitoses* and cell division is probably brought about, so that the cells disintegrate slowly and are absorbed. While this phenomenon does *at times occur* under radiotherapy, it has been encountered more frequently under roentgen



Fig. 488. Enlarged photograph of radon seeds at the top; glass tubes in the center and needles below.

therapy. Pettitt[708] quoted Regaud as stating that by using a fractionating dose of the *ray, cells, both normal and pathologic, are* much more susceptible to radiation effects during the period of mitosis than in the resting stage, and that by fractionating and prolonging the period of administration over a number of days, many more cells *could* be trapped during mitosis, a most important and definitely basic discovery.

This regression is followed by fibrosis[128, 928] or connective tissue replacement, which in itself retards cell proliferation. In order to obtain a greater depth dose relative to the surface effect of the radium rays, filters *of various substances are used, the more* important of which are platinum,[110, 161, 652, 928, 932] gold,[127, 128, 140, 151, 652, 694, 928, 932, 1018] silver,[110, 151, 1018] lead,[127, 128, 140, 652, 932, 1018]

rubber,[119, 151, 162] brass,[127, 128, 149, 151, 912] aluminum,[127, 652, 1018] and copper.[127, 652, 694, 1028] This effect may be accomplished also by increasing the distance.

When in use, radium must be placed in special containers which take the form of plaques, needles or seeds. (Fig. 488.) Plaques consist usually of a metal support in which radium element or emanation is distributed uniformly over the surface and covered by a thin substance which permits utilization of the soft alpha and beta radiation. Needles are small platinum tubes having a point impregnated with iridium and an eye through which a wire can be passed. In the body of the needle is a cavity into which insoluble radium salt, usually the sulfate, is uniformly packed. Emanation sealed in fine glass capillaries may also be inserted into these needles. Seeds can be fine glass capillary tubes into which the emanation or "radon gas" is placed. After the seeds are sealed they are encased in tubes of platinum to avoid necrosis from the beta and softer gamma rays. These seeds are removable, in which case a silk thread is attached to them. The radon gas can also be put in fine gold tubing cut in lengths about one-eighth inch long. These are left in situ.

Methods of Use. In the treatment of anorectal cancer, radium may be employed in three ways.

1. External radiation consists of the application of rays from without by means of packs or applicators containing the radon element or emanation. It may be used alone or in conjunction with roentgen rays.[480, 864]

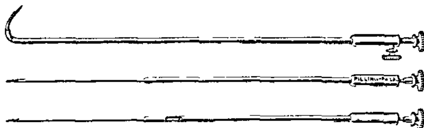


Fig. 489. Applicators for the intratumoral implantation of the radium seeds.

2. Intratumoral, or interstitial, implantation consists of the insertion of needles or seeds into the tumor mass. Gold-filtered emanation seeds are usually employed. (It has been estimated that the effective irradiation of the implants is equal to three times that of an equal amount of emanation applied to the surface.)[1067] This use of sources of radiation in a growth itself was the first step in the curative treatment of cancer within the body. Bare glass radon tubes were first applied to rectal tumors by Quick[829] and by Kelly and Ward.[538] Knowledge of the effectiveness and more uniform dosage with gamma radiation has brought about a transition to greater filtration with the various heavy metals, thus eliminating all beta rays. Binkley,[127, 128] with many other radiologists, used these gold-filtered radon seeds following their devisal by Failla.[332] Martin, Quimby and Pack,[667] by their determination of the lethal tumor dosage, made it possible for many radiotherapists to effect the destruction of even rectal malignant neoplasms, although recovery had generally been deemed unusual. Overdosage seems to be as serious as the reverse in treatment when roentgen radiation or interstitial implants alone were used. Epithelial and tumor cell reaction to extended radiation has been described by Ewing,[324] relevant to his theory of adaptation, who stated: "The normal epithelium acquires a resistance to the rays by the process of adaptation, and is able to regenerate under a dosage which originally destroyed the pre-existing epithelium. At the same time the tumor cells, subjected to

exactly the same dosage, do not exhibit that power of adaptation and regeneration but perish and, in this respect, they differ from normal cells. Upon this *difference the cure* of the cancer seems to depend, for the normal epithelium may regenerate and the cancer cells do not."

Due to variation in the extent of the local disease at the *time of treatment and* variation in the grades of malignancy and radiosensitivity of rectal cancer, no uniform dosage or technic of application is suitable for all cases coming under observation. The technic which *had proved to be of* greatest value in Binkley's clinic was the preliminary use of external applications of radium or high voltage roentgen rays, supplemented by interstitial implantations or local surface *application of radon,* as external therapy seemed to exert a favorable influence upon the tumor. This is not always sufficient, using present-day (*circa* 1939) technic, to obtain the highest degree of palliation or the complete eradication of the neoplastic growth. Gold-filtered radon seeds have been in use for many years, but, during the past three years, Binkley has employed, in many of his cases, small, daily, surface dosage of radon replacing the interstitial procedure and has found this type of treatment to be just as effective. It is, *obviously, well known that rectal* carcinoma is insidious in its onset, and while the majority of these carcinomata, on microscopic examination, prove to be of low-grade malignancy, they possess a marked tendency *to metastasize to vital organs, and the out*come in untreated cases is invariably fatal. A German authority, in 1937, studied a large series of untreated cases of rectal carcinoma and found that most of the patients survived but a year or two following establishment of the diagnosis; 90 per cent lived from one and a half to two years, 7 per cent *for three, and only* 1 *per cent* were alive after five years from the onset.[360] Bowing and Fricke's treatment was essentially the same as that followed by Binkley.

3. The third form of radium application, intrarectal in type, embodies the application of tubes or needles to the surface of the tumor. Shedden,[912] in discussing Bowing *and Fricke's technic, claimed that* a disadvantage accrued from its use because, while a heavy dosage of radium was delivered to the surface of the growth, obviously, a weak dose was delivered peripherally. The intra*cavitary tube method cures but rarely.* Coffey[229] became so discouraged with the procedure that he flatly stated he would never again use radium rectally except for some extraordinary reason.

In employing the intrarectal type of treatment, Shedden used seeds filtered with 0.3 mm. gold and 1 mc. in strength, embedded in the tumor via the rectal lumen, with a total dosage of from 10 to 60 mc. *He believed that the use of from six to eight* of these seeds usually gave too severe a reaction and observed that abroad they were using a filtration of 0.6 or even 0.8 mm. in order to screen out further beta radiation. Cade[185, 186] used this filtration in needles, finding that with this screening there was less resultant necrosis and a corresponding increase in possible irradiation periods.

Roentgen Ray. Under this caption, external radiation or deep therapy represents the surface application of high-voltage roentgen rays *directed about the pelvis* at several portals of entry. It is valuable as a palliative procedure, especially in inoperable cases where the tumor is not accessible for the implantation of radon seeds, in those operable cases where radical surgery is refused or as a preliminary step to operative procedures.

According to *Bowing and Anderson,*[148] primary tumors of the rectum are but slightly affected by these rays, although it has been admitted that the rays do emit uniform radiation and are capable of inhibiting lymphatic extension. Yeomans[1071] believes they destroy metastatic nodules. Roentgen rays are less frequently the cause of *sloughing than are the radium rays.* In this connection, the author had made brief

mention elsewhere in this volume of the newer work being done as a result of the use of nuclear fissional elements in which all filtration media are eliminated in the barrage of tumor growth in small animals, only that portion of the body impregnated with boron compounds being acted on by the slow neutron rays. As to whether this phenomenon would react in like manner when applied to humans is for the future to decide. It is much too soon to venture any definite opinions.

Combined Irradiation. Irradiation which combines the use of radium and x-rays may be employed alone or in conjunction with surgery. In either instance the treatment should be selective, since irradiation is not applicable in all cases. The determining factors and, obviously, the results, will depend on the physical condition and age of the patient; the size and location of the cancer, whether at the anus, low in the rectal ampulla or in the sigmoid; the grade of malignancy and its radiosensitivity; the structures invaded and the extent of metastasis. Bowing[150] stresses the value of estimating the grade of malignancy in every case prior to deciding upon any plan of attack.

In the treatment of anorectal malignancy with radiation therapy several methods may be employed. A brief description of the more important procedures follows: Fitzwilliams,[356] Sharp,[928] Bowing and Fricke,[151] and Neuman and Coryn[736] favor a preliminary colostomy and the intratumoral insertion of radium, both through the lower loop of the colostomy opening and through the rectum. Fitzwilliams' method is as follows:

> From four to six weeks after the colostomy has been performed, a narrow sigmoidoscope is introduced into the lower bowel loop until the growth is visualized, and a well protected tube containing 30 mg. of radium is inserted into the growth and allowed to remain *in situ* for from four to five hours. The following day the growth is approached through the anus with the same dosage and for the same length of time. Following a rest period of one day, the entire procedure is repeated. Approximately 500 mc. hours of radiation are given directly into the growth. Three courses similar to this are given at intervals of one month.

Sharp and his co-workers[928] treated 13 out of 28 patients with high voltage roentgen therapy to skin tolerance, radon seed implantation, and, in most of the patients, the intratumoral implantation was combined with removable perirectal radium needles. Of the 13 receiving this treatment 7, or approximately 50 per cent, are free of disease or postmortem examination failed to disclose evidence of the presence of malignancy. Two additional patients have been living with disease five and eight years, respectively, and the remaining four are dead of disease. By the combination of roentgen irradiation, intrarectal radon seeds and perirectal radium needles, a lethal dose of radiation was delivered into the growth with minimum effect in the surrounding normal tissues. The division of the interstitial radiation was satisfactory and appeared due to (1) radium sources both within and surrounding the tumor mass; (2) long, uniform sources limiting the depth dose from the needles; (3) certainty of the delivery of the planned dose as contrasted with the possible loss of radon seeds; (4) serial application, rather than a single caustic dose; (5) the added filtration of the needles completely eliminating the beta rays, and (6) less contracture of the lumen and incidental pain from the combined interstitial radiation.

Quick[829] employs a combination of buried emanation, filtered radium internally and externally, and surgical exposure where indicated. For annular growths he uses 0.5 mm. platinum tubes, arranged end-to-end in a small rubber tube which, in turn, is encased in a large rectal tube. In this way he has been able to use 500 mc. hours per tube without danger of reaction. Where the tumor is confined to one portion of the rectal wall, he advocates a bougie of solid rubber with platinum tubes in its grooves. Kelly and Ward[538] advise implantation of

radon seeds into the growth through a proctoscope; according to their determination, 1 mc. of radium emanation is sufficient to destroy 1 cc. of tumor tissue. Binkley[126, 128, 129] makes use of the same procedure, using an applicator fashioned after an electrically lighted proctoscope. These are slightly heavier than the ordinary instrument, the thickness being one-sixteenth of an inch of brass, acting as a filter for the radium. The diameters vary from 1.5 to 2.5 cm. and the length from 10 to 25 cm. They have a movable shoulder which may be fastened with a thumbscrew so that the length of the tube inserted into the rectum is varied in accordance with requirements. These applicators possess the advantage of being easy to place over the tumor by direct vision and to fasten into position. The holders containing the radon are modified obturators which fit within the instruments.

Others vary their treatment according to the type of growth; e.g., in cancerous rectal stricture Yeomans[1073] inserts tubes of rubber in tandem formation within the lumen. For papillary growths, Jones[515] distributes needles of emanation tubes throughout the tumor and for large, flat, ulcerating lesions he uses a flat, oval applicator which contains the radium tubes. Neuman and Coryn[735] advocate interstitial irradiation following surgical approach and considered it valuable in operable cases where the growth is situated below the peritoneal reflection. Briefly, the procedure used by them is as follows:

Colostomy is instituted as a preliminary step, and, following a rest period of seven or eight days, the coccyx is resected and the rectum exposed. Platinum needles 16 mm. in length, having a screenage of 0.5 mm. and containing 0.6 mg. of radium, are inserted into the growth at right angles to the long axis of the rectum. Where the tumor is small, the needles are introduced obliquely approximately 1 cm. from each other. The area cephalad and caudad to the tumor, as well as the retrorectal and ischiorectal fossae, is irradiated with platinum needles placed longitudinally. All needles are threaded with strong linen thread, the ends being brought through the incision in the skin and tied. After a period of from five to seven days, or when the total dose of 10,000 mg.-hours has been given, the needles are withdrawn. In some cases, especially with a persistent discharge, the rectum is excised as a third procedure. Additionally, in the female, the growth may be attacked intravaginally.

These authors advocate deep roentgen therapy after a period of two months. In a series of 59 cases, 46, or 77 per cent, of which were inoperable, they report that two-year cures were obtained in over 50 per cent of the cases. Contraindications to the use of the procedure are the resultant pain, the slow and tedious convalescence and, terminally, a chronic urethritis and cystitis. Gabriel,[379] on the other hand, employed this method in 89 cases, concluding that the results were unsatisfactory. The same experience was encountered by Gadaucheau.[381]

For growths located above the peritoneal reflection, Gordon-Watson[414] made use of transperitoneal radiation (radon seeds placed intra-abdominally) in an effort (a) to barrage lymphatic spread along the inferior mesenteric vessels at the time of colostomy, as a preliminary step to radical excision; (b) to attack a fixed inoperable growth; or (c) in operable cases where a radical procedure was contraindicated. Although this method was employed in but a small series, the results obtained were discouraging. Binkley[113] urged the more frequent employment of colostomy and perineal resection plus irradiation, additionally urging partial surgical removal in inoperable cases plus irradiation.

Lockhart-Mummery[618] believes that the intra-abdominal insertion of radon seeds should be preferred to needles, as where intra-abdominal irradiation is employed, the dosage varies from 2,500 to 6,500 mg.-hours. Transperitoneal irradiation has been deemed a very risky procedure, perforation of the bowel and peritonitis being terminal occurrences. Many investigators feel that recurrence is more likely to follow the use of radon than with the radium element. Gordon-Watson's[415] technic was to drain the peritoneal cavity, employing rubber

sheeting with Coffey's gauze wick drains to pack off the irradiated area until the needles were removed. In his series of 16 cases there were six operative deaths; one was alive and well 2½ years postoperatively; recurrence followed in the remainder. Shedden[912] used posterior barrage in nine cases, treating the lines of spread along the hemorrhoidal arteries. From 30 to 60 mg.-hours of radium are employed, according to the size and extent of the growth. The wound is packed with gauze kept moist with Dakin's solution. The skin wound is kept temporarily closed until the radium has been removed. Where rectal perforation seems likely with this procedure, the perineal operation is omitted and an attempt is made with intrarectal seeds fortified with perirectal needles passed through the perineal skin. Those employing this technic feel that if a growth is adequately barraged with radium and shows little evidence of retrogression after two months, obviously it would be quite useless and a waste of time to repeat the procedure. There were two postoperative deaths; one died of late secondary hemorrhage; two are alive and well two years, and one other one year and two months following treatment; three of the cases required hospitalization for more than three months.

Binkley stated that radiation therapy, using the modern technic, had definite advantages, such as short hospitalization periods; avoidance of the dangers and inconveniences of radical surgery and retention—in most instances, of a normally—or practically so—functioning rectum. Rankin and Graham, quoted by Malbin and Stenstrom,[652] made the statement that 50 per cent of those surviving surgery are not alive at the end of five years. Daland, Welch and Nathanson[261] reported five-year survivals as only 30 per cent among all those operated on, accounted for by early metastases in 68 per cent of the cases, with regional lymph node lesions demonstrable at the time of surgery. Where surgery is contraindicated, irradiation or electroco-

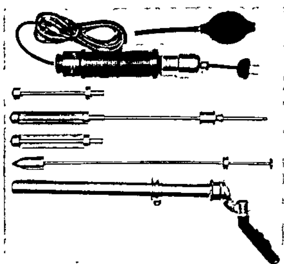


Fig. 490. Sigmoidoscope employed for radium pack.

agulation is suggested by Malbin and Stenstrom as a therapeutic measure. Schreiner[917] reported eight cases of inoperable carcinoma of the rectum with survivals of from 5 to 13 years and no evidence of recurrence following radiotherapy. He recommended the external phase followed by radon seed implantation of the residual tumor. On the other hand, Fricke and Bowing[368] administered roentgen therapy to nine patients, none of whom was alive after five years. The authors believed that adequate irradiation of malignancies located rectally is more than merely palliative, as it definitely increases life expectancy. In some cases inoperable tumors became amenable to surgery and in a small percentage of cases, cures have been effected by irradiation. McCormick[694] and his co-workers irradiated 68 cases, 70 per cent of them becoming definitely improved; 30 per cent showed but slight improvement. The author did not believe that radium played any appreciable role in palliation. The progressively decreasing number of patients suitable for this form of treatment can only be subjected to roentgen irradiation. Colostomy frequently can be avoided under these circumstances and should not be attempted except in the presence of impending obstruction. However, if numerous metastases

radon seeds into the growth through a proctoscope; according to their determination, 1 mc. of radium emanation is sufficient to destroy 1 cc. of tumor tissue. Binkley[126, 128, 129] makes use of the same procedure, using an applicator fashioned after an electrically lighted proctoscope. These are slightly heavier than the ordinary instrument, the thickness being one-sixteenth of an inch of brass, acting as a filter for the radium. The diameters vary from 1.5 to 2.5 cm. and the length from 10 to 25 cm. They have a movable shoulder which may be fastened with a thumbscrew so that the length of the tube inserted into the rectum is varied in accordance with requirements. These applicators possess the advantage of being easy to place over the tumor by direct vision and to fasten into position. The holders containing the radon are modified obturators which fit within the instruments.

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tion, and external radiation at a later stage. Yeomans prefers exposure of roentgen rays through six portals of entry, each being treated three times in periods of thirty minutes apiece. He repeats the course in from six to twelve weeks.

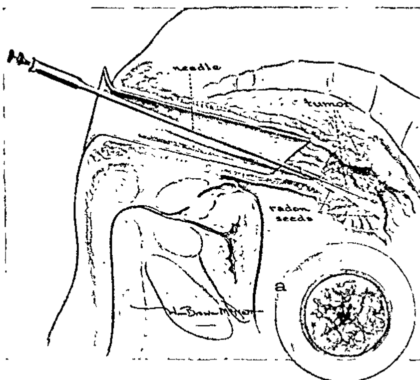


FIG. 491. Sagittal drawing showing method of inserting the radon seeds. (a) Proctoscopic view.

In discussing the preoperative treatment of rectal carcinoma, Bowing and Fricke[149] stated that this phase is much more aggressive than heretofore. As a rule the lesions are smaller and more accessible. Their series comprised 58 cases; 27, or 46 per cent, of the series are dead, the number including five who died of postoperative complications where surgery had been combined in treatment; one died following operation elsewhere; one died following radium treatment, one of cerebral embolism and 10 died from distant metastatic involvement. Of these 27 dead, 19, or 70 per cent, underwent colostomy and 13, or 53 per cent, excision of the rectal carcinoma. The average interval between excision and treatment was 3.2 months, the average length of life being one year and five months. Thirty-one are alive and well, 19, or 61 per cent, having had colostomies and 24, or 77 per cent, underwent excision. The average length of life up to the time of publication of the article was 2½ years. Careful microscopic examination of pathologic tissue was carried out in each case following surgical excision. In three, no evidence of carcinoma whatsoever was apparent in the specimen, radium treatment having destroyed all vestiges of growth. In three others, the pathologic report indicated that most of the malignant cellular elements had been eradicated.

Several years ago the writer, who served in the Department of Radiology at the Philadelphia General Hospital, had the privilege of observing a large group of patients in whom therapy was administered prior to operation. Compared to the group in which no preoperative treatment was

or extensive involvement render completion of an attempted resection inadvisable, then it may at times be justifiable to do a colostomy, if the growth has been removed. Reuther[864] is of the opinion that radium therapy alone or in combination with other methods is indicated in various types of cases, among them being anal epithelioma and adenocarcinoma of grade four malignancy and moderately advanced lesions in patients who are considered poor surgical risks. He cautions against too heavy dosage, as radiation proctitis will invariably develop. He believes it of value in preventing postoperative hemorrhage following electrodesiccation of rectal cancer. Howes and Shapiro[480] stated that a "frozen" pelvis may be benefited to some degree by roentgen therapy. Supervoltage apparatus does not appear to offer increased advantage thus far.[694, 1027] Uhlmann and Grossman[1002] made use of radon ointment as a means of differentiation between radionecrosis and recurrent carcinoma, and the former investigator[1001] discussed its significance and the management of injuries incident to radiation.

Sheddon[932] believes that the radium pack or bomb with or without accompanying high voltage roentgen treatment is a method well worth considering. As used in the Memorial Hospital in New York, the pack contains 4 grams of radium. It is applied at from three to seven portals of entry about the pelvis, the maximum dose at each portal being from 50,000 to 60,000 mg.-hr. at 15 cm. from the skin. The filter at the portal is 0.35 mm. of platinum and 1.5 mm. of brass. The total maximum dosage is 200,000 mg.-hr. It is much too early either to recommend or condemn this method. High voltage roentgen therapy may also be employed to produce from 100 to 175 per cent S. E. D., i.e., 900 r at each portal.

Where radical surgery is to be combined with irradiation, Binkley[125] employs external therapy alone in cases where adequate dosage of radon cannot be given or when the growth is situated above the peritoneal reflection. A full erythema dose is given through each of six portals three weeks before operation. He uses external and interstitial irradiation as follows: in perineal resection a full erythema dose of external irradiation is given, followed by a colostomy in three weeks; after a lapse of one week, gold seeds are implanted, and the resection is performed from seven to ten days later. In the one stage, abdominoperineal resection, external radiation is given primarily and followed three weeks later by the interstitial insertion of gold seeds. The operation is performed from one to three weeks later.

Palliative Treatment. In the advanced cases, external irradiation is employed in sufficient intensity to restrain the activity of the growth. Here from three-quarters to one erythema dose of high voltage roentgen ray is given through each of six portals in one or two applications, with treatments daily or on alternate days. It does not damage the skin and may be repeated at one or two month intervals. Binkley remarks,[123] "Irradiation usually offers the inoperable patient much greater palliation, without the possibility of an immediate fatality, than that provided by incomplete removals."

Pre- and Postoperative Irradiation. Opinions differ as to the value of radiation therapy before and after operation. May[678] advocates the use of roentgen rays preoperatively and postoperatively, and employs this method routinely. Larson[594] believes that large, inoperable growths may sometimes be rendered operable by these rays; while Schmieden[912] considers this to be occasionally true even though metastasis to the liver has occurred.

According to one writer, approximately one half of the patients who are subjected to radical surgery die of cancer. If such is true, postoperative irradiation should be advocated in an effort to prevent recurrence. Binkley, for example, favors the interstitial implantation of radon seeds at the time of or immediately following opera-

Treatment of Inoperable Cancer

Too frequently patients suffering from inoperable cancer offer a real problem; while the results to be obtained are of little permanent value, effort should be made to institute means by which these unfortunate individuals may become more comfortable. Sympathetic understanding, kind nursing care, appetizing food and treatment designed toward the control of irritating discharges, odors, decubitus ulcers, etc., may do much to improve a patient's condition, at least psychologically. Even greater than the importance of judgment in the choice of a procedure is the real need to recognize when the pain of cancer has become intractable.

The treatment of intractable pain is dependent upon its origin, location, frequency, duration, the type of tissue involved and the condition of the patient both physically and mentally. Pain due to underlying organic disease may be greatly exaggerated by some individuals and minimized by others.

The use of colloidal metals, carbon dioxide snow, electrocoagulation and endosection have been discussed elsewhere in this chapter (see pp. 703-707). Irradiation therapy, which has been found useful in presence of metastatic bone involvement, has also been described previously (see p. 712-714).

In some instances the injection of various drugs has been found of value, for which reason their technic is described and brief comments made.

Regional Nerve Block. Nerve block is the simplest and most direct method of relieving intractable pain. By this method various agents are injected into or around the spinal cord, spinal root nerve or peripheral nerves. It serves to inhibit pain conduction along its path from its point of origin to the sensory areas of the brain.

A thorough knowledge of the anatomy is a prerequisite to the relief of pain. Although local infiltration into peripheral areas may give relief, it is more satisfactory to attack the source of pain through the paravertebral route.

Procaine hydrochloride or metycaine hydrochloride in a one per cent solution is a complete, though temporary, analgesic and enables one to identify the nerves which carry pain sensation.

Magnesium Sulfate. Two cc. of a 25 per cent solution of magnesium sulfate is injected intramuscularly for intractable pain. Lundy[633] recommends that it be administered with morphine sulfate, ¼ grain, two, three or as many as six times daily.

Pitcher Plant. For almost two centuries it has been known that the distillation of a suspension of powdered *Sarracenia purpurea* (Pitcher Plant) in alkaline solution produced a volatile base. In 1931, it was observed by Judovich and Bates[90] that the distillate prepared in this manner was of value in relieving pain of neuralgic origin. It became apparent following injection that motor weakness did not occur, nor loss of touch, pressure or temperature sensibility. The duration is more prolonged than procaine; it appears to be nontoxic, harmless, and no evidence of tissue coagulation or sclerosis has been found. Pharmacologic studies show the aqueous solution to contain ammonium ions. Experimentally, by blocking a sciatic nerve, it was proven that the ammonium ion has the ability to exert a selective action not possible with procaine, for normal skin sensations and reflexes were preserved while the pain and hyperalgesia disappeared.

Paravertebral Injection. The lumbar nerves lie between and anterior to the transverse processes of the lumbar vertebrae and anterior to the transversalis muscle. The ilio-inguinal and the iliohypogastric nerves are important branches of the twelfth thoracic and first lumbar nerves, and supply the anterior abdominal wall. Beginning with the second lumbar, the nerve trunks assume a downward course, situated very close to the bodies of the lumbar vertebrae.

given, the results were such that the author has seldom deemed it of sufficient value except in an occasional case. In the few instances of an acute ischiorectal abscess occurring while patients were being prepared

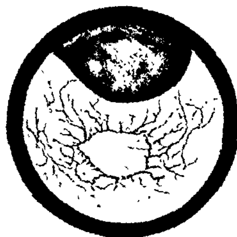


FIG. 492 A. Pearly plaque giving elevated appearance. Note the vessels radiating from the periphery of the plaque. H. E. Bacon: Radiology 29:574-577.

for radical resection, we have employed x-ray therapy following incision and drainage and postponed the resection for from three to four weeks.

Reactions and Complications of Radium and Roentgen Rays. The prolonged application of radium will cause a destruction of tissue similar to that produced by roentgen rays.[51] Hyperemia of the rectal mucosa develops from one to two weeks after considerable radiation. Frequently the patient complains of a burning or smarting sensation in the rectum, accompanied by the discharge of mucus. In severe cases an ulcerative proctitis may occur, in which case the pain is often excruciating. Malaise, anorexia and loss of weight are coexistent. Benign stricture of the rectum and radio necrosis of the sacrum, coccyx and bladder are occasionally encountered. According to David,[203] severe radium burns of the rectum practically always result when intratumoral implantation is employed rather than radium packs applied at a distance. (Fig. 492 A.) In Shedden's experiences, complications encountered were: 10 operative deaths; one late secondary hemorrhage and 2 rectovaginal fistulae. In connection with the latter complication, Black and Waugh stated that sufficient irradiation to destroy cervical carcinoma may result in certain complications occurring in adjacent structures, especially the rectum and rectosigmoid, and in support of their contention they reviewed a case of stricture of the rectosigmoid and repair of a rectovaginal fistula following radium therapy for carcinoma of the cervix. The authors quoted Wigby, who compiled 100 cases, finding that 57 per cent of them had some rectal complications and of these, only 7.9 per cent were late reactions requiring definitive treatment. They also quoted Todd, of London, who recorded rectal involvement in 5 per cent of all his cases. Complications, such as may occur from the use of x-rays and especially radium, which are termed "factitial proctitis"[102] have been reported by Cannon and Murphy writing in Turner's "Modern Operative Surgery."[997] The author has reviewed this condition in an article published in 1937.[51] Buie and Malmgren[175] also published their findings, reporting the condition as occurring in three per cent of cases in which irradiation had been employed for cervical carcinoma. Mandl[658] quoted Todd, who in a Hunterian lecture referred to the condition, describing a rectal ulceration following irradiation treatment of cancer of the uterus and, on digital examination, the lesion so closely simulated carcinoma that it was named "pseudocarcinoma of the rectum." Two distinct types were recorded: one restricted to the rectal wall, the other involving the perirectal tissues with secondary rectal involvement. Our experience with factitial proctitis in various sites following irradiation for a condition, especially cancer, has been considerable. The management pertinent thereto has been discussed under Factitial Proctitis, Chapter 9, Proctitis and Sigmoiditis.

diluted with the spinal fluid, mixed and injected into the spinal canal. The head should be kept well below the plane of lumbar puncture during the procedure. Following the injection of the mixture, the patient is placed flat on his back for one hour, after which he may be leveled. The dosage recommended is 200 mg. diluted in 50 cc. of spinal fluid, each cubic centimeter of spinal fluid containing about 4 mg. of ammonium salt. The hydrogen ion concentration of the ammonium salt solution is adjusted to 7.2 with ammonium or sodium hydroxide before being placed into ampules and autoclaved.[431] To prevent postspinal headache, the patient should stay in bed for 24 hours.

This procedure is very painful without procaine spinal anesthesia.

In an average individual not addicted to the drug, morphine ¼-⅓ grain, with 3 grains of a barbiturate may be administered. Atropine sulfate, 1/75 grain, will diminish nausea and vomiting. According to Judovich and Bates,[88, 89, 521, 961] this method is of value, and results are favorable where pain is due to root irritation. Hand, in attempting to duplicate the work of Judovich and Bates, found his results less satisfactory.

Comment. This method of therapy presents certain dangers and is sufficiently hazardous to warrant extreme caution in clinical application. Magnesium sulfate has produced a similar clinical and pathologic picture. It is well before attempting this form of therapy to inform the patient and family of all possible complications, securing written permission.

Alcohol. Dogliotti,[300, 301] in 1931, proposed the subarachnoid injection of absolute alcohol for the control of intractable pain. According to Stern,[958] alcohol in certain concentrations in the spinal canal will relieve pain and cause only partial analgesia. He is of the opinion that motor paralysis is produced when the alcohol is injected in greater concentrations and quantities. The technic described by Dogliotti is as follows:

Before the alcohol is injected, preoperative medication of morphine and a barbiturate is given. It is necessary, also, to determine which segments are involved. Since the specific gravity of absolute alcohol is lighter than spinal fluid, the patient is placed in the left lateral position, on the side opposite to that affected. A pillow or kidney-lift is used under the patient opposite the posterior roots involved in order to arch the spinal canal so that that portion of the canal will be higher than any other portion of the canal. Since alcohol is lighter (hypobaric), it will seek the highest level; therefore the head and shoulders should be placed below the site to be injected. A spinal tap is made using a 21-gauge needle opposite the affected nerve roots (usually 1st lumbar interspace). One cc. of spinal fluid is withdrawn and discarded. Contained in a 1-cc. syringe, from 0.5 to 8 cc. of absolute alcohol is injected slowly. After remaining in this position for 20 minutes, the patient is rolled over and placed on his back for several hours. Keeping the patient in bed for 24 hours may prevent headache and meningeal irritation.

Disadvantages. One must be ever mindful of the fact that the subarachnoid injection of alcohol may be a hazardous procedure. It is well always to warn the patient and especially the family and obtain written permission because of the possible complications and sequelae, such as paresthesia, loss of sensation and motor paralysis, urinary and fecal incontinence, cranial nerve paralysis, headache, hypotonicity of musculature and recurrence of pain.

Results. Saltzstein[890] obtained good results in 10 of 11 cases, and Stern,[958] in treating 19 cases, noted complete relief in 12, partial relief in five, and failure in two. A mixture of 60 per cent absolute ethyl alcohol and 40 per cent absolute methyl alcohol is preferred by one.[311]

Comment. It has been the author's custom to employ alcohol as an intermediary step between irradiation on one hand and rhizotomy or cordotomy on the other. Our results in approximately 50 cases have been at no time uniform, but the relief obtained in a small fraction seems worthy of trial. In all instances we adhere closely to the

Technic of Injection. To inject the twelfth thoracic and the first lumbar nerves, the patient is placed in a prone position with a pillow under the lower abdomen in order to bring the spinous processes and lower ribs into prominence. As the spinous processes of the first and second lumbar vertebrae are palpated, a skin wheal is made 3.5 cm. lateral to the midline on a plane with the upper edge of each spinous process. Employing a three-inch, 20-gauge or 21-gauge needle, it is passed into the tissues perpendicular to the plane of the skin for a distance of from four to six centimeters to make contact with the transverse process. After locating the transverse process, the needle is withdrawn and redirected until further insertion clears the transverse process. It is advanced approximately three centimeters deeper than is required to make contact with the posterior part of the transverse process. At this site, from 8 to 10 cc. of pitcher plant distillate is introduced into or near the twelfth thoracic nerve. In order to inject the lumbar nerves, 1, 2, 3 and 4, the needle is introduced in the same manner to contact the posterior aspect of the transverse processes of the lumbar vertebra. It is passed over the upper edge and advanced three centimeters beyond for injection of the nerves. Where it is desirable to inject the fifth lumbar nerve, the same procedure is employed except that the needle is passed below the fifth lumbar transverse process. The dosage of the distillate is from 5 to 10 cc. for each nerve.

Sciatic Nerve Injection. The sciatic nerve originates from the fourth and fifth lumbar and first and second sacral nerves. Its course in passing out of the pelvis is through the great sciatic foramen below the pyriformis muscle and downward between the greater trochanter of the femur and the ischial tuberosity.

Technic of Injection. With the patient lying with the affected side up, the thigh is flexed on the trunk at an angle of 135° so that the long axis of the femur points toward the posterior superior iliac spine. A line is drawn from the upper extremity of the greater trochanter to the posterior superior iliac spine. At the middle of this iliotrochanteric line, a perpendicular line downward is drawn for about three centimeters. This will locate the point at which the needle is to be inserted. At this point a three and one-half inch 20-gauge needle is inserted in a direction perpendicular to the skin until the needle makes contact with the bone at a depth of from six to eight centimeters. This depends upon the weight of the patient. When the sciatic nerve is located, from 10 to 20 cc. of the agent are injected. Injections may be given daily for a series of from five to ten without ill effects.

Sacral Nerve Injection. The sacral nerves may be injected by inserting needles through the posterior sacral foramina or through the caudal canal by epidural injection. The technic of inserting the needles is the same as described under transsacral block. Injection into the caudal canal may be performed through the sacral hiatus as described under caudal analgesia. The dosage of pitcher plant distillate to be injected is from 3 to 5 cc. for each sacral nerve. Ten cc. are employed for the caudal injection.

Subarachnoid Injection. Due to the danger of loss of sphincter control when alcohol was injected intrathecally, Bates and Judovich[90, 520] experimented with the ammonium salts, both ammonium sulfate and ammonium chloride. In an effort to avoid motor disturbances of the bladder and bowel, these investigators modified their original technic. Since the ammonium salt solution is hyperbaric or heavier than spinal fluid, the method employed is the reverse of that used for intraspinal alcohol injection. The painful side is down, and, if the pain is bilateral, the patient is placed flat on his back with head and shoulders elevated. The modified technic is to place the patient on the side with head down and hips elevated. The lumbar puncture is performed and 50 cc. of spinal fluid are withdrawn. The ammonium salt solution is

Kraske[562, 564] revolutionized the operative procedure in 1885 by presenting a method offering wider removal of growths in the middle and upper thirds of the rectum. Although this method still has its proponents in some of the major clinics in Europe, it has become obsolete in this country, and in its place has been substituted the abdominoperineal procedure. Innumerable modifications of this technic have been offered. Schede,[898] for instance, in 1887, advised a preliminary colostomy, while Bardenheuer[91] divided the sacrum below the third sacral foramina.

All modifications of the Kraske operation may be divided into two schools—those which remove increasingly larger amounts of bone, and those which employ methods for the temporary reflection of portions of the sacrum such as osteo-integumental flaps. But irrespective of the sacral procedure, this operation may be performed as either a rectal resection or an amputation. After dividing the sacrum transversely above the cornua of the coccyx, Levy[607] made two parallel incisions downward to a point two inches above the tuberosity of the ischium. One of the most ingenious modifications was that of Rehn and Rydygier,[837, 895] in 1893, in which a curvilinear incision was made from the posterior superior iliac spine parallel to the sacrum down to the coccyx. After division of the attachments of the sacrosciatic ligaments on the same side, the sacrum is cut transversely below the third sacral foramina and chiseled through so that the osteotegumentary flap thus formed may be raised backward and replaced following excision of the rectum. Proctectomy by the vaginal route was performed in 1890 by Desquins[284] and gained prominence through the efforts of Rehn,[838] McArthur,[693] Byford[184] and Murphy.[746] Chaput,[210] in 1894, excised the rectum by the abdominosacral route, while Quénu, who was an ardent advocate of the combined procedure, delivered the growth through the abdomen after isolation by the perineal route. Reverdin, the same year, reversed the procedure. Kraske,[560] impressed with the splendid exhibition of the basin of the pelvis from above, indorsed the combined method and suggested a preliminary laparotomy to determine the extent of metastasis. In America, not only had the combined procedure won popularity, but the stage method was also enthusiastically developed.

General Remarks

The fact must never be forgotten that untreated cancer is absolutely a fatal disease, carrying with it an average duration of life of approximately eighteen months from the onset of symptoms. Cancer of the bowel is a curable disease, provided an early diagnosis is made and radical surgical removal instituted. An immense responsibility is placed on the surgeon in that he must advise appropriate treatment suited to the individual patient, treatment that will offer the patient the greatest hope for survival with minimal risk. He must be familiar with factors which determine resectability or the reverse and, if resectable, what criteria govern the choice of procedure; he should also be thoroughly familiar with survival rates in terms of tumor gradation. Invariably he will be confronted by both the referring physician and the patient's family with such pertinent questions as: "Isn't my father too old to be operated on?"; "Can you remove the growth entirely?"; "What are his chances? Will he be cured?"; "Will the evacuations be in the normal site or in the abdomen?"

General Condition of the Patient. Both the extremely obese and the markedly malnourished patient are poor surgical risks, especially for such radical procedures as the abdominoperineal operation. Quite the contrary, this by no means precludes radicability. Complicating diseases, among them marked arteriosclerosis, advanced cardiorenal disease, extreme hypertension, active pulmonary tuberculosis, or uncontrollable diabetes, may, however, contraindicate radical surgery.

described technic. The first injection is one-half cc. consuming two minutes for the administration. If relief is not obtained, three-quarters cc. is injected from approximately five to seven days later. We have noted two instances of partial paralysis of the leg, and some degree of bladder and bowel incontinence in one where 1 cc. was administered.

Alcohol injected into the caudal canal has been mentioned by Lundy, De Beule and Schotte. We have employed the epidural route in two instances, but in the author's opinion it is not a method to be recommended.

Surgical Treatment. Surgery on the central, sympathetic or peripheral nervous system for relief of intractable pain should be attempted only when other methods of alleviation have failed. Posterior rhizotomy represents section of a sensory root central to its ganglion of origin. It produces a permanent sensory loss and causes no interference with motor function. Because of absence of the neurilemma sheath, regeneration does not take place. The popularity of this procedure has decreased and is now more or less relegated for those cases in which the pain arises from isolated spinal nerves, as in intercostal neuralgias or in tabetic root pain. Cordotomy (chordotomy) or section of that portion of the spinal cord which contains the lateral spinothalamic tract containing the sensations of pain and temperature has replaced posterior rhizotomy. Bilateral cordotomy produces loss of ejaculatory reflex, although it does not incapacitate the patient sexually. Sympathectomy on the main sympathetic chain has become popular. Additional references on the management of intractable pain are to be found by Gabriel,[381] Sawyer,[903] and Malbin.[652]

Summary. Our approach to the problem and management of intractable pain incident to inoperable cancer of the lower bowel is to irradiate all patients. In the interim, the usual remedies as codeine and aspirin, or demerol may be used. We have employed cobra venom in approximately 40 cases with moderate alleviation in eight instances. One cc. is injected intramuscularly every day until from six to eight are given. Where x-ray therapy fails to offer relief, pitcher plant (serapin) is injected. If ineffectual, then alcohol is administered intrathecally. Quite recently a glutamic acid compound known as teropterin has been employed in several instances, but, since our experience has been so meager, one cannot draw conclusions. One cubic centimeter (10 mg.) is administered by intramuscular injection each day for at least one week; thereafter the dosage is increased as tolerated. In one case a daily dose of 4 cc. was given for three months with some relief of pain. As a last resort, cordotomy is selected. Morphine and dilaudid, of course, must be employed, but with discretion.

SURGICAL TREATMENT

Historical Sketch

Although Littré[615] performed sigmoidotomy in 1710, and Faget[331] amputated the rectum in 1739, the first name to stand out pre-eminently among the earlier writers because of successful extirpation of the rectum is that of Lisfranc.[610, 611] The operation covered a very circumscribed area, however, and was limited to growths in the anal and lower rectal region. In 1839, Amussat[18] performed the first lumbar colostomy, and in 1844, Denonvilliers modified Lisfranc's operation by continuing the incision to the coccyx. Later Chassaignac[211] employed an écraseur. Colostomy, although a palliative measure, was at this time the approved surgical treatment, since it prolonged and made more comfortable the patient's life and avoided the dangers of radical operation.

In 1884, Czerny[258] attempted to remove a cancerous growth by the perineal method but, owing to the high-lying position of the tumor, was forced to complete the operation by th bdominal route, thereby performing tne first combined procedure.

ment or adjacent structural invasion, while another may deem the lesion distinctly and definitely resectable.

The appended table is representative of the percentages of resection compiled by various surgeons both here and abroad. The attention of the reader is invited to these tabulated figures, in order that a comparison of those obtaining one and two decades ago and those depicting the present rates may be made (Tables 69 and 70).

TABLE 70. EUROPEAN CLINICS' REPORTS

Name of Operator	Location	Year Reported	Percentage of Resectability
Goetze[405]	Erlangen	1935	86 0
Miles[720]	London	1931	32.0
Poppert[814]	Gieben	1930	64.0
Enderlen[317]	Heidelberg	1925	55.0
Kirschner[547]	Königsberg	1932	53.0
Pässler[783]	Tübingen	1935	44 0
Steck[955]	Göttingen	1932	47 0
Payr[787]	Leipzig	1934	43.0
Kuttner[578]	Breslau	1928	37.0
D'Allaines[8]	Paris	1946	80 0
Oppölzer & Nitsche[1014]		1942	60 9
Ballivet[77]		1946	84.0
Mandl[656]	Jerusalem	1946	66 7
Pettinari[797]	Bologna	1933	61.0
Bastianelli[87]	*Rome*	*1937*	*70 0*

In connection with factors relevant to either operability or resectability of cancer originating in this locale, it may be well to enumerate indications for or against radical extirpation.

Indications. While no set dictum may be made governing all patients having malignancies originating in this region, as a general rule it may be stated that any growth, regardless of size, location or duration, not fixed to important structures too extensively, and free of diffuse metastasis, should be given the opportunity of excision provided, of course, the condition of the patient warrants such intervention.

Contraindications. Obviously, radical surgery is contraindicated in the presence of acute obstruction and acute perforation, where distant metastasis has occurred, for example, the lungs, brain or bones (coccyx and lower sacrum at times excepted), and diffuse hepatic invasion; and in the presence of widespread peritoneal metastasis or where there exists marked fixation of the growth with adjacent organ infiltration, especially the trigone of the bladder.

Abdominal Exploration and Determination of Extent of Metastasis. Exploration of the abdomen should proceed in orderly sequence. As soon as the abdomen has been opened, the dome and undersurface of the liver are palpated for nodules. Following inspection of the small intestine, gallbladder, kidneys and omentum, the large bowel is palpated clockwise, beginning at the ileocecal junction and terminating just proximal to the lesion. The next step is careful exploration of the pelvis and determination of the extent and mobility of the malignant process as well as regional lymph node invasion. Abdominal exploration, therefore, is the sole means of ascertaining whether intra-abdominal metastasis has occurred, except in advanced cases (large nodular liver and ascites). For this reason alone, it is the only method of determining growth resectability. Absence of palpable nodes in the liver is a reliable index, although it should be comprehended that secondary deposits may be deeply situated in the liver substance and demonstrable only at necropsy. Some difficulty arises when small superficial nodes are evident on the liver surface, inasmuch as they may be of fibrous origin, in which event they possess no pathologic significance. It is here that aspiration biopsy may become a valuable adjunctive procedure. Judgment and experience are essential in differentiation, or the case may be classified as "inoperable."

Mayo and Schlicke reviewed 12 cases wherein the surgeon entertained doubt as to the presence of liver metastasis. At necropsy, 50 per cent revealed secondary growths. Confusion in distinguishing between cancerous nodules, cysts, tubercles, infarcts, hemangiomata and cirrhosis has been adequately discussed by numerous writers. Quite uncertain and equally mis-

Age of the Patient. Until a decade ago, one of the chief factors interdictive of resection was age; then, as at present, numerous instances arose where the individual was well over 70, 75 or even 80, and recovery ensued from a formidable procedure, the patient remaining well over a period of years. Today, with the individual evaluation of each patient on admission, careful and adequate preoperative preparation, fractional spinal analgesia, postoperative care directed especially toward maintenance of fluid, nitrogen, acid-base and caloric balance, early bed elevation and frequent change in position with early ambulation of the patient, age, per se, does not assume the concern heretofore accorded it as a contraindicative factor. In all cases, however, the judgment of the surgeon, governed by the various points mentioned herein should be the deciding factor.

Quite recently Pack[1103] called attention to the great margin of error in recording end-results of treatment for cancer and the loose use of the term operable and inoperable. Three variable factors, according to this investigator, influence any surgeon when he pronounces a given cancer nonresectable: first, the age of the patient and the coexistence of degenerative diseases which might complicate cancer; second, the extent of the disease, i.e., the degree of local or organic involvement, the specific organ or tissue implicated, the extension to and incorporation of neighboring viscera by the cancer and metastasis to regional and distant sites; and third, the surgical philosophy, moral point of view, courage and experience of the surgeon.

Resectability or Irresectability. In any large general hospital, it will invariably be found that from 70 to 75 per cent of patients having rectal cancer are not resectable at time of operation. These percentage brackets were true of the Philadelphia General Hospital and they conform with the reports compiled by other investigators[266, 457, 902] throughout the country.

In private and ordinary hospital practice, from another tangent, the resectable percentage is definitely higher.

TABLE 69

NAME	REPORTED YEAR	NO. CASES	RESECTABILITY	OPERABILITY
Hayden & *Shedden*[457]	*1930*	*63*	*21 %*	..
Rankin[842]	1931	.	34.9%	...
Rankin[843]	1934	300	50-68 %	. .
Rankin[839]	1942	258	74.8%	...
Rankin[840]	1947	167	75.1%	...
Shedden[930]	1942	166	72.3%	..
Hayden[455]	1939	82	76 6%	...
Hayden[457] .	1936	303	65-70 %	..
Hayden[456]	1945	217	91.2%	...
Coffey[228]	1934	82	47.2%	...
Yeomans[1070]	1929	..	58 %	...
Jones, D. F.[501]	1936	672	63.5%	...
David[266]	1936	..	60 %	...
Lahey[583]	1936	..	70 %	...
Lahey[584]	1946	.	83 %	. .
Cattell[199]	1943	335	83.5%	..
Cattell[201]	1947	..	90.7%	.
Fansler[339]	1934		55 %	...
Fansler[338]	1944	100	70 %	...
Jones, T.[513]	1935	127	79 %	...
Raiford[832]	1935	..	{32.4% {63.5%	... . .
Babcock[36]	1937	220	77 %	..
Babcock[26]	1946	559	97 %	...
Miles[715]	1939	.	65 %	...
Brindley[156]	1937	76	52.4%	...
Pratt[819]	*1938*	*40*	*40 %*	...
Scarborough[904]	1939	95	75.8%	...
Pfeiffer[800]	1941	82	59 %	...
Silvers[935]	1942	100	66 %	...
David & Gilchrist[269]	1942	277	65.8%	...
Romano & Trachtenberg[876]	1943	228	38 %	...
Shallow[927]	1943	100	75 %	...
Vynalek[1016]	1947	486	35.6%	...
Baker[156]	1944	.	60 %	...
Cave[208]	*1944*	*84*	*72.6%*	...
Berger[101]	1944	41	70.7%	...
Daniel[263]	1945	private	80 %	...
Besser *et al.*[109]	1945	348	43 %	...
Johns[501]	1947	63	80.8%	...
Bacon & Gass[62]	1944	256	80.2%	...
Bacon (Group A)	1948	800	87.7%	..

The personal equation entering into estimation of resectability is evidenced by wide variants in these percentages compiled by different surgeons. As an example, one operator may consider a patient unfitted for surgery because of such factors as advanced age, obesity, malnutrition, hepatic involve-

hepatectomy had been carried out confirms the validity of the worthwhileness of such a maneuver."

Rationale of Abdominal Colostomy. While this subject has been discussed elsewhere, it appears advisable to state that an artificial abdominal stoma is, in certain instances, of definite value, being often a life-saving procedure. Limiting these remarks to malignancy of the bowel, colostomy possesses the greater value in the presence of acute, complete or unrelieved colic obstruction and as a preliminary procedure to radical extirpation. Although all artificial abdominal stomata are abominations not at all desirable, the attendant distastefulness and inconvenience are not to be compared with its value in specific cases, since it is quite true that a colostomy will temporarily improve the general health of the patient. *Obstruction is precluded, with the added* facility of cleansing the distal bowel. Its establishment also tends to diminish the distressing diarrhea and irritative discharges, lessens toxicity and offers the possibility of converting an inoperable into an operable growth. We have observed the latter result in numerous instances. It is the general consensus that with a chronic, obstructive lesion, preliminary colostomy lessens mortality following resection. There is no question of it being helpful in relieving tenesmus invariably associated with anal and low-lying rectal growths. While the procedure possesses no direct inhibitory effect on lesional growth, its establishment may add either months of happiness or an equal period of misery as a result. The estimated life expectancy is prolonged on an average of from six to seven months,[387] which is concurred in by most surgeons.

It is the author's uncompromised opinion, however, and not just the personal expression of an hypothesis, that colostomy has been a method born of expediency and used with needless frequency, even many times where not indicated, in view of the presenting symptomatology, and at other times much too soon, even if its subsequent performance were indicated. There is not the slightest doubt of its value in the presence of acute complete colic obstruction, but even here it should be kept in mind that such incidence is confined to a mere five per cent. In the event of a presenting chronic or unrelieved obstruction, a proximal colostomy, cecostomy, appendicostomy or transversotomy becomes a *justifiable procedure*, since it is considered but a temporary measure and is closed following resection. In anal and low-lying rectal lesions within six centimeters of the anal margin, an abdominal colostomy, as such, is an integral part of the extirpation and is definitely recommended. We have determined as a result of statistical surveys made in two groups of cases that approximately 20 per cent of all malignant lesions involving the anus, rectum and sigmoid are located in the distal *six centimeters of the intestinal tube*. For growths involving the sigmoid, colostomy, provided it is done by the Mikulicz technic, is but a temporary procedure, although the stoma formed as a result of using the Hartman procedure is permanent. This subject is given detailed consideration under sigmoidal cancer. (See p. 805.)

"Why should a colostomy be avoided?" is a logical question. How many times, after stating that an artificial opening on the abdomen is imperative, have we heard patients say, "Doctor, I would rather die than have a colostomy!" One is prone to wonder how many patients have died needlessly by refusing such an operation when radical surgery by other means was not made available to them. Surely, many 3-, 5- and 10-year cures could have been effected. Whether one likes to admit it or not, too often, colostomized patients are socially ostracized, a train of psychoneurotic manifestations may be suffered even to the point of suicide, marriage may be interfered with and many are unfit for *employment and are thereby refused* a means of livelihood. Every surgeon will have in his files records attesting this fact. As Horsley[184] stated a few years ago:

leading is the visible and palpable interpretation of lymph nodes at operation. Experience has proved that large palpable nodes are less often carcinomatous than the small, hard variety. Since such glands may be inflammatory, the size, feel and position, even though definitely presumptive, must not be considered an efficient method of determining malignancy for the purpose of negativing or precluding radical excision. Metastasis to the lungs and bony structures may be revealed by radiographic study. Extension to adjacent organs, such as the prostate and vagina, may be revealed by the palpating finger, and urinary bladder invasion by cystoscopy.

Type and Grade of Growth. The greater majority of malignant lesions are adenocarcinomata. In any event neither type nor grade should influence the decision for operation, since the larger value is expressed in terms of postoperative prognosis.

Rationale of Resection in the Presence of Metastasis. The question repeatedly asked is: "What is the rationale of removing a cancerous bowel in the presence of hepatic involvement, glandular metastasis (upper mesocolic and aortic) and where extension to structure such as the bladder, vagina, prostate, urethra, seminal vesicles, ureter, uterus and adnexa, small intestine and the appendix has occurred?" A glance at Tables 69 and 70 will illustrate the extended plan of attack by surgeons here and abroad over a period of years, showing that a sincere effort has been put forth to increase the degree and rate of radicability. There is some evidence quotable that where the primary or mother growth is removed, secondary deposits or metastases grow with less rapidity (sarcomata and the malignant melanomata being excepted). Lahey[584] observed an average survival rate of 25 months with the palliative removal of growths in the presence of moderate degree of metastasis in the liver. He remarked: ". . . these patients live twice as long, are much more comfortable while they live and die infinitely less distressing deaths." The position taken that radical removal should be accomplished in such circumstances has universal acceptance today, especially by every one dealing with these cases in any appreciable numbers. Babcock cited a case that lived eight years with hepatic involvement, while the writer recently observed a patient whom he resected four years and eleven months previously. It is quite evident that an increasingly radical attitude relevant to surgical management of advanced malignancy has been taken which assuredly appears justified. For example: in 100 cases of advanced intra-abdominal cancer, Brunschwig[168] noted that 12 per cent surviving operation averaged four years and returned to normal full-time activities; five per cent averaged 2.5 years, also returning to usual activities; 12 per cent lived up to 12 months receiving palliation, and, 23 per cent survived up to 14 months. The reported operative mortality was 34 per cent. Sugarbaker[972] considers radicalism justified, due to the fact that 19 patients of a group of 34 advanced cases of the colon and rectum survived up to five years following surgical intervention. In 13 cases of extended resection, Glass and Garlock[1002] reported a mortality of 15 per cent. There was one recurrence after one year; one was well five years later and nine were alive and well an average of 18 months following operation. Babcock and the author[1003] cited 29 cases of extended resection with a mortality of 13.7 per cent. Other reports[107, 236, 270, 403, 927] equally confirmative are available. Disposition of both adjacent structural and lymph node invasion has been adequately discussed in the foregoing pages.

In terms of limited knowledge at present extant, the author cannot subscribe to the removal of localized secondary deposits in the liver at time of or subsequent to palliative resection. The available reports need to be evaluated and careful consideration given to whatever merit the procedure may possess.[203, 1022] Just recently, Wangensteen stated, "A more protracted period of observation of

promises greater benefit to the particular patient should be selected and, for this reason, the surgeon should be familiar with and competent to perform any or all of the accepted methods of procedure.

The surgical approach to cancer involving the anus, rectum and sigmoid is through the abdomen, the perineum or by a combination of both. In some instances, however, the perineovaginal approach is indicated and, although many factors do bear influence, some type of abdominoperineal operation is the prescribed method of choice in the greater majority of cases.

Location. In a general way it may be postulated that for growths involving the anal canal or lower rectum, perineal excision is applicable; for those in the middle and upper rectum, rectosigmoid and lower sigmoid, an abdominoperineal or combined procedure; and for those in the sigmoid, a sigmoidectomy.

Perineal Excision. This method does not permit the wide removal of the gland-bearing areas that is accomplished by the abdominoperineal method. It should be reserved, therefore, for those growths well below the peritoneal reflection and where the patient is not in condition to withstand the more radical abdominoperineal procedure. If the sphincters are involved by the cancerous process, or the growth is within approximately three centimeters of the anorectal line, these muscles must be sacrificed. In general, perineal excision is easy to perform, less shock is encountered, good drainage is afforded, and postoperative complications are less frequent.

Lockhart-Mummery, who advocates perineal excision following a preliminary colostomy for growths at or below the rectosigmoid, believes that little is gained by the abdominoperineal method, since it permits removal of only a little more of the pelvic peritoneum and lymph nodes of the pelvic mesocolon.

As a basis we may begin with the premise that the mortality rate of perineal excision is lower than for the combined abdominoperineal method, although the recurrence rate in the former is higher than in the latter. From the standpoint of cure, the abdominoperineal procedure should be irrevocably chosen. Suppose, however, we study carefully a comparative review of recent data by Dukes.[307] In a series of 1,000 cases of rectal cancer treated by excision, he concluded that 80 per cent of those without, and 20 per cent of those with metastasis would have stood just as good a chance of cure had they been treated by perineal excision. Dukes remarks, "The champions of the combined method may declare that by substituting the combined for the perineal operation, they have given a better chance of cure to at least half their patients." The defenders of the perineal method may reply that the combined surgeon submits about half his patients to an unnecessarily extensive operation. A comparison of the total survivors after excision of the rectum treated by perineal operation (391 patients) and combined (514 patients) shows very little difference. Where the operative deaths are included, then the perineal group showed 40.9 per cent alive after five years, compared to 39.2 per cent of survivors from the combined operation. Conversely, by excluding the operative deaths and limiting the comparison to operative survivors, then 47.1 per cent were alive after five years with the combined, compared to 44.9 per cent with the perineal method. The operative mortality of the entire group was 15 per cent for the combined and 8.7 per cent for the perineal procedure.

Abdominoperineal Excision or Resection. This combined method is an operation of great magnitude. It is the most radical, inasmuch as it permits wide removal of the gland-bearing tissues, as well as the diseased bowel. The opportunity afforded for exploration of the abdominal cavity is a distinct advantage, since detection of widespread metastasis would avoid the performance of a futile resection. All growths of the anal canal, rectum and lower sigmoid are amenable to excision by the

"Something more than mere existence should be included in the operatives of surgery;—if a patient can be made more comfortable after a procedure that offers equal chances of cure of the cancer as other operations, it is obvious that this technic should be adopted." The author's main criticism is directed not only to the unnecessary establishment of a permanent colostomy for all cases, as is usually performed, but also to its indiscriminate use in the presence of an ineradicable cancer with absence of obstruction or its indicated imminence. *Time after time*, upon exploration and encountering an inoperable or an apparently irresectable growth, the operator feels that he must "do something" and, as a result, he performs a colostomy. This attitude obtained in the not-so-distant past, in fact one operator made the assertion that "*When in doubt, do a colostomy.*" There is no doubt of the concurrence of all concerned that an abdominal stoma with removal of the growth is, under no circumstances, to be compared with colostomy where the growth is permitted to remain. The situation is deplorable in young subjects and especially those of advanced age, or those in poor circumstances and devoid of a sympathetic understanding who find themselves dependent on the mercy of their relatives and friends or else become a ward liability in a hospital at a time when beds are at a premium. In our department, colostomy is employed in acute colic obstruction; in some cases where, upon exploration, occlusion seems imminent, in the presence of unrelieved chronic obstruction as a preliminary to resection, as an integral part of extirpation for anal and low-lying rectal growths, and temporarily as in the Mikulicz-Rankin procedure for sigmoidal growths.

Many of our confreres have assumed the obligation to set aside substantiated records of studies and survival rates in an effort to defend an inherited or traditional method of procedure. Our colleagues have championed the perineal anus and speak of a perineal colostomy as being synonymous. Quite a few have criticized the procedure without ever having performed such an operation and, *perhaps in many instances*, without taking the trouble to follow the results attained, either early or late. Were one to be captious and contentious about questioning the feasibility of the arguments which have been tendered, it might be stated that experience has shown that those who have sanctioned an abdominal colostomy and who consider means to avoid an artificial stoma as "sentimental nonsense," have, in our experience, been the first to select a method to eliminate one for themselves and their family.

Let it be definitely understood that it is not our purpose to condemn "colostomy," but rather to emphasize that the procedure, per se, is undertaken needlessly much too often. Furthermore, attention is invited *to the end results achieved*, both as to function and rates of survival.

It is to be sincerely hoped that among the great surgeons of tomorrow there will arise some who, without bias, will approach the problem in a fair and impartial manner and make a sincere effort to further evaluate the rationale of various procedures to eliminate a colostomy in a larger group of cases and for a period of 10 and 20 years.

Choice of Operation, Resection, and *Method of Approach*. The cardinal objective in the treatment of cancer is the preservation of life and, for carcinoma of the lower bowel, this is best achieved by radical surgical extirpation. *Therefore, limited or* conservative methods for removal are, under these circumstances, definitely interdicted. By the same token, either roentgen or radium therapy should assume no justifiable inclusion in the attempted cure of cancer located in this region. One should be ever mindful that there is no existing criterion available in selecting the type of procedure and furthermore, no one method is applicable in all cases. In each, the procedure should be adopted to fit the individual patient, and not the patient to the operation. In other words, a procedure that

In resection, on the other hand, the diseased bowel is removed and the two segments, namely, the proximal and distal, are united by suture. The "telescope" or "pull-through" method may also be included under this heading and consists of drawing the proximal segment down through the distal portion around which are the sphincter muscles. Resection by the perineal or parasacral route is seldom performed in this country, or rather, it would be better to say that it has been discarded by such surgeons as Babcock and Berg because of the frequency of faulty union, with resultant fistulae. For sigmoidal growths, resection in stages is commonly performed, although immediate anastomosis is rapidly gaining in popularity. End-to-end suture of the sigmoid and upper rectum has to its credit a distinguishing list of proponents, pertinent remarks to which will be discussed under Cancer of the Sigmoid Colon (see p. 811).



FIG. 492 B. M. S., age 74. Extended resection. This specimen shows cancer of the sigmoid, uterus, tube and ovary and approximately one foot of ileum. The patient was discharged on the thirteenth day postoperatively.

Evaluation of Statistics Pertinent to Operability, Resectability, Recurrence and Survival. Statistics as a science should be a classified arrangement of authentic data, but as applied by those of us in the medical profession, it is too frequently a conglomeration of compilations devoid of basic understanding and interpretation. As one attempts to decipher many ill-defined published articles at hand, the reader becomes enmeshed in a mire of confusion. Certainly some attempt should be made to formulate a simplified method of reporting intelligently case surveys to serve as an authentic index for the physician of tomorrow.

Operability and Resectability. Much confusion is manifest because of the loose usage of the words "operable and resectable," as a result of which, conclusions cannot be accurately drawn from many series of cases reported in the literature. It is generally understood that resectability refers to the removal of the cancerous bowel or whatever the process may be, such as, cholecystectomy or hysterectomy. Operability, on the other hand, is a more general term employed to connote such procedures as exploratory laparotomy, colostomy, etc. On occasions it may be used as we use it, to include resections. Suppose, for example, that a surgeon, Doctor A, examines 100 patients with bowel cancer. The bowel is resected in 75, so that the resectability rate is 75 per cent. However, another 10 patients are simply colostomized, and two are explored and closed. Therefore the operability rate is 75 plus 10 plus 2, or 87 per cent. In another instance, Doctor X has examined and found cancer in 100 patients. In 10, he institutes fulguration or radium and x-ray therapy; five seek counsel elsewhere. The remaining 85 are admitted to the hospital and all are submitted to operation. Is the rate of operability based on those admitted to the hospital (85 cases—operability 100 per cent) or on those found to have cancer on examination (85 per cent operability)? Also, suppose that in 50 of the patients admitted, the cancerous growth is removed.

abdominoperineal technic. This, the combined method, may be performed in either one or two stages.

Sacral Excision. This method of approach may be performed for growths in the middle and upper rectum in which the coccyx and usually the lower sacral segments are removed. This method does not permit exploration of the abdomen, a sacral anus is unsatisfactory, infection is not uncommon,[790] and, although the immediate mortality rate is low, the percentage of recurrence is high.

Pruitt[822] cites the compilations of the British Ministry of Health in regard to the chief types of radical operation in various countries in the following form:

In our department, the removal of additional structures, such as the uterus and adnexa, segments of infiltrated bladder, the ureter, the abdominal wall, the adjacent vagina and small intestine, have increased but little the rate of mortality in a single stage. Lest this statement be misunderstood, let it be said that at all times a sincere effort is made to perform that which is best for the individual patient.

Amputation and Resection. For the purpose of clarity, it may be well to describe each briefly. Where amputation is performed, the diseased bowel and usually the sphincter muscles are excised, the proximal stump being closed (extraperitoneally) and left in situ. This is characteristic of

Country	Total "Radical" Operation	Perineal	Sacral	Combined	Abdominal Only	Anal or Vaginal	Not Stated
England	573	344	97	51	6	...	75
		60 0%	16.9%	8.9%	1.0%	....	13.1%
France	169	65	5	52	1	1	45
		38.5%	2.9%	30.8%	0.6%	0 6%	26.6%
Belgium	41	30	2			....	9
		73 1%	4.9%			. .	21.9%
United States	1,255	137	78	127	20	20	872
		10.9%	6 2%	10.1%	1.6%	1.6%	69 5%
Switzerland	181	145	29	5	1	1	....
		80 0%	16.0%	2.8%	0.6%	0.6%	....
Germany	1,673	542	864	129	2	50	86
		32.4%	51.6%	7.7%	0.1%	2.9%	5.2%
Hungary	188	22	154	8	.	...	4
		11.7%	81.9%	4.3%			2.1%
Austria	1,289	21	1,197	54		5	12
		1.6%	92.9%	4.2%	.	0.4%	0.9%
Czechoslovakia	193	45	2			....	146
		23.3%	1 0%		.	...	75.6%
Scandinavia	193	4	17	12		.	160
		2.1%	8.8%	6.2%			82.9%

Multiple-Stage or Graded Operation. Until a decade ago, resection in stages was the accepted procedure for rectal cancer. Such methods were recommended by D. F. Jones, Coffey, Smith, Rankin, Kirschner and Lahey. While it must be stated that occasionally the two-stage maneuver is indicated, experience has shown that, with fractional spinal analgesia, careful preoperative and postoperative care and refinements in technic, the lowest mortality and morbidity occur with resection in one-stage.

Lockhart-Mummery's procedure, namely, colostomy and posterior excision. Some surgeons, such as Lynch and Hamilton,[639, 641] have modified the Cripp's method to avoid an abdominal colostomy by amputating the rectum with sphincter muscles through a perineal approach. The proximal stump remains in situ, but no attempt is made to bring it down to the perineum. Rather, they establish over a period of months a long, fibrous tube through which the evacuations pass.

hold the bitter truth. Yet at the same time, it is our belief that the patient is deserving of some degree of frankness. In every instance, the referring physician and some responsible member of the family are advised of the true nature of the condition. In the absence of relations, disposition varies according to the individual case. Thus, having shared the responsibility, when asked by the patient, "Doctor, do I have cancer?—you can tell me—I must know," invariably we advise that a growth or tumor is present which must be removed by operation. If insistent, the patient is advised that were the growth permitted to remain, cancer will undoubtedly develop. Occasionally, where a patient procrastinates, the blunt truth is made known to him. If the formation of a permanent colostomy is contemplated, the patient should most certainly be told and advised as to its nature and purpose.

To the author, it is a miscarriage of not only trust, but integrity as well, for the surgeon to submit a patient to surgery without first discussing the possibility or probability of the establishment of such an artificial stoma. Yet, customarily, patients obtain their first intimation of a colostomy when the initial abdominal dressings are removed. It indeed is to be heartily deplored.

Preoperative Treatment

The ultimate success of any operation, and more particularly those procedures dealing with the colon and rectum, depends to a great extent on the preoperative preparation and postoperative care. Since publication of the second edition just six years ago, the care of the patient in terms of newer concepts has approached such magnitude that the subject has been compiled in a separate chapter, to which the reader is referred (Chap. 28).

Anesthesia

The selection of an anesthetic is of utmost importance, especially when a formidable procedure, such as an abdominoperineal excision, is to be performed. Although general anesthesia still has its proponents, there has arisen a gradual trend toward the use of spinal as the anesthesia of choice, inasmuch as it contributes less to the operative mortality. Since all phases of anesthesia have been discussed elsewhere in detail, it is unnecessary to repeat the numerous advantages of spinal; yet it should be stressed that there is little doubt that greater speed and better visualization are permitted when it is employed. Prevention of trauma is the best-known preventive of postoperative adhesions, which, in turn, are the principal cause of postoperative obstruction. Broadly speaking, spinal analgesia is ideal and offers a wider range of applicability than general anesthetics, such as ether, nitrous oxide and ethylene.

In our department, the choice is fractional or continuous spinal analgesia, using 0.3 per cent pontocaine in 7 per cent dextrose solution. Sodium pentothal, curare, the gases and intravenous morphine, are employed as supplementary agents (Chap. 26).

Radical Extirpation of the Rectum

The methods employed today for the radical removal of cancer are based on fundamental principles and, although differing somewhat in technical details, they have reached a high degree of standardization. These procedures have stood the test of time and are still employed in our department with success and satisfaction. Undoubtedly the combined excision of Miles is the procedure most popular and therefore the one most frequently performed, with colostomy and posterior excision (Lockhart-Mummery) a close running mate, especially in certain quarters of the globe. Contrary to common belief, we do not condemn the Miles procedure, which is frequently performed in our department, but its use is confined to selected cases. We have always contended that the surgeon who is doing rectocolonic surgery in any large amount should have knowledge of and be capable of performing not one

Group A (Author's Series)	No. Patients Found to Have Cancer	No. Patients Operated Upon	Operability Rate	No. Deaths from Operation	Mortality from Operation	No. Patients Resected	Resectability Rate	No. Deaths from Resection	Mortality from Resection
Cancer patients examined ...	800	.	. .	...	...	...	...	...	..
No procedure recommended (too far advanced, brain tumor, active tuberculosis, coma, metastasis to lung or bone) .	25		. .	...	...	...	..	. .	. .
Refused operation or sought council elsewhere	24			...	..	..	...	...	...
Fulguration	24		.	.	...	...	...	...	...
Exploration only	9	9	.	0	0	...	. .	...	...
Palliative colostomy .	32	32		4	12.5	..	.	..	. .
Local excision a. Bevan alone or with radium implantation .	21	21		0	0	.	.	...	...
b. Sigmoidotomy	27	27		0	0	...	.	...	...
Resection	638	638		33	5.1	638	87.7	. .	5.1
Total .	800	727	90.8%	37	5.1%		87.7%	33	5.1%

Is the resectability rate based on the 85 patients admitted (58 per cent), or on the 100 cancer cases examined (50 per cent)? It was our custom until recently[1095] to estimate the rate of resectability on the total number of patients with neoplastic disease, but following the suggestions of Jones,[540] Babcock[29] and Pemberton,[1081] we have computed the rate on the number of patients submitted to operation. This is shown in the above chart (Group A) and is here represented as 87.7 per cent.

It will be noted that cases treated by fulguration and local excision are not included under the heading of resection, since strict classification is distinctly obvious. There are other points of confusion, such as the arbitrary method of determining what constitutes an operative death. Ordinarily we employ a 21-day period after resection for a death to be considered an operative mortality, as suggested by the late W. H. Mayo. Some writers use a two-week period, while others base their estimation on 30 days. Again, one writer may report a 75 per cent five-year cure and inadvertently fail to mention that the number of operative deaths and cases with liver metastasis were excluded from the series, while another in the same surgical clinic will simply cite a 50 per cent survival rate of five years. One author will publish his experience in terms of cure of from one to five, or three to five years; a second, five years alive and well, and still another just five years (alive and well, or alive with recurrence).

If those of us who publish our reports would but conform to some plan, as recommended by Newman,[757] much confusion would be eliminated.

What Should Be Told the Patient

The approach to this question is at times a difficult one and not without repercussions. One preceptor of the author was prone to offer but little information and simply stated that an operation was necessary, as a result of which the writer absorbed the brunt of the usual questions following the surgical episode. The other, whose service was confined to the treatment of malignant disease, invariably told the patient quite frankly that he or she had cancer and that operation offered the only hope for cure. While our approach to the problem, which is largely a psychologic one, may be open to criticism by our medical confreres, effort should be made to with-

hold the bitter truth. Yet at the same time, it is our belief that the patient is deserving of some degree of frankness. In every instance, the referring physician and some responsible member of the family are advised of the true nature of the condition. In the absence of relations, disposition varies according to the individual case. Thus, having shared the responsibility, when asked by the patient, "Doctor, do I have cancer?—you can tell me—I must know," invariably we advise that a growth or tumor is present which must be removed by operation. If insistent, the patient is advised that were the growth permitted to remain, cancer will undoubtedly develop. Occasionally, where a patient procrastinates, the blunt truth is made known to him. If the formation of a permanent colostomy is contemplated, the patient should most certainly be told and advised as to its nature and purpose.

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TABLE 71
AUTHOR'S SERIES

(GROUP A)		NO CASES	DEATH	PERCENTAGE
Abdominoperineal proctosigmoidectomy	After Babcock	401	20	4.9
Abdominoperineal excision—1-stage	Miles	110	3	2.7
Abdominoperineal excision—2-stage	Lahey	7	1	14.3
Sigmoidectomy—multiple-stage	Mikulicz-Rankin	38	3	7.8
Sigmoidectomy—single-stage	Open or closed	34	3	8.8
Perineal excision with colostomy	Lockhart-Mummery	26	1	3.8
Anterior resection	Hartmann	18	2	11.1
Perineo-abdominal	*Gabriel-Turner*	*2*	*0*	*0*
Perineal excision	Cunéo-Sénèque	2	0	0
Totals		638	33	5.1

but several of the accepted procedures. With this in mind, the more standard methods will be described, and, for the purpose of reference, others will be briefly mentioned. At all times an honest attempt should be made to avoid "that common surgical sin," as Fallis speaks of it, "of adapting the patient to the operation." As shown in the foregoing table from the author's series, Group A, the choice has been proctosigmoidectomy, the abdominoperineal excision (Miles), colostomy and posterior excision (Lockhart-Mummery); and for sigmoidal growths, the Mikulicz-Rankin exteriorization method with a tendency to lean toward immediate end-to-end anastomosis. While employed in but a few instances, the Lahey and Hartmann procedures have been utilized in the presence of definite indications.

Progress, however, depends upon changing ideas and developments, this being especially true in the science of medicine. Pertinent to the management of cancer or, for that matter, other types of lesions in the lower bowel, our attention was drawn to a technical procedure, evolved through the pioneer work of Babcock, in which we became keenly interested. In the ensuing discourse, it is the desire of the author to render an honest and unbiased opinion of his experience in a group of patients sufficiently large for the reader to judge the merit of such opinion and form his own conclusions therefrom.

The rational approach to the problem appears to be an intimate discussion of the subject "proctosigmoidectomy," its evolution, indications, contraindications, advantages, disadvantages, the technic, its comparative rates of mortality and morbidity, complications and sequelae peculiar to the procedure, sphincter continence, incidence of local recurrence and survival percentage.

EVOLUTION OF METHODS TO ELIMINATE COLOSTOMY

A review of the literature in native and foreign tongues discloses that much effort has been made to eliminate abdominal colostomy in the treatment of rectal and low sigmoidal cancer.

In 1833, Reybard[805] of Lyons removed a cancerous growth from the sigmoid flexure of a man aged 28 years. The tumor was excised with 3 inches of intestine and the two ends stitched together, replaced within the abdomen, and the wound closed. Although the patient lived 10 months, Reybard's method was severely criticized by the Paris Academy of Medicine.

Dieffenbach,[290] in 1845, left the pararectal musculature intact following resection of the rectum by suturing the proximal to the distal segment. The Lisfranc[610] operation, consisting of a restricted excision of the rectum and introduced in 1826, had fallen into disuse but was revived and modified by Verneuil[1007] in 1873 .to preserve the sphincter muscles and offer a less restricted

operative field. The results were scarcely improved, however, the mortality being about 80 per cent and recurrences taking place in almost every instance. There were, nevertheless, persevering surgical pioneers seeking the best treatment for this ravaging disease, and in 1875 Kocher,[558] following resection of the tumor, anastomosed the segments of the bowel, thereby retaining sphincter control, which was a decided improvement. About this time, too, the use of antiseptics became general, and, perhaps due to both these advances, the mortality rate fell to 60 per cent, with practically no change in the frequency of recurrence.

Gersuny,[393] in 1878, excised the cancerous rectum and made a three-quarter twist of the bowel before attaching it to the anal skin. After amputation of the rectum, Witzel[1060] sutured the proximal end of the bowel to the skin through slits in the pyramidalis and gluteus maximus muscles; Rydygier[895] employed only the gluteus. Perron,[795] too, maintained continence by approximating the ends of the gut in a manner not unlike that advocated by Kocher.

New impetus was given the surgical treatment of rectal cancer by Kraske,[562, 563, 564] who, in 1885, offered a method for growths in the lower, middle and upper thirds of the rectum. After excision of the coccyx and a segment of the sacrum, the rectum was resected and continuity established by circular suture, provided the proximal segment would reach the anus. The mortality dropped to about 20 per cent, and other contemporary surgeons using Kraske's method obtained even lower percentages. Recurrence was less frequent but remained between 70 and 80 per cent. Where the continuity of the bowel was established, nonunion at the suture line, necrosis from insufficient blood supply and sepsis occurred.

Shortly thereafter, Heineke[460] proposed an osteo-integumental flap to support the sphincter and levator musculature. Invagination of the upper rectal segments through the lower end, following excision, was performed by Hochenegg,[490] and to this the

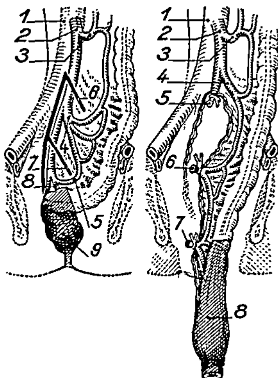


Fig. 493 A. Arrangement of arterial pattern and points of ligation. (Paitre and Dupret.)

name "pull-through" or *Duerchzug* method was applied. In an effort to avert the formation of a fecal fistula, he removed the modified skin from the anal canal prior to the process of invagination.

Eichhoff, Pribram, Payr and Deitrich also preferred this method. In 1888, Allingham[14] of England devised a method which subsequently attained wide recognition. An incision was made in the midline from the tip of the coccyx to, but not including, the posterior wall of the rectum. The external sphincter was divided anteriorly, then a circular incision was carried around the bowel between the internal and external sphincters so as to leave the latter muscle attached to the skin of the anus. The levator ani muscles were divided close to the bowel, and the rectum was isolated by dissecting close to its wall. The pelvic peritoneum was not opened, but the bowel was divided about an inch above the growth. Under the heading of abdomino-anal excision, Maunsell,[676] in 1892, described a

method which was later improved upon by Weir,[1037] Ball[76] and Aldrich-Blake.[7] Mobilization of the rectum and sigmoid was effected through an abdominal incision, and the inferior mesenteric artery was ligated below the origin of the lower sigmoidal branch.[890] A ligature was tied around the bowel at a point considered most suitable for joining the anus. The freely movable bowel was pushed into the pelvis, and a peritoneal diaphragm was reconstructed. After closure of the abdominal wound, an incision was carried around the anus to the coccyx, the sphincter and levator muscles being separated in the midline. The diseased bowel was pulled through the pelvic floor and excised. The end of the proximal segment was then fixed to the levator ani and sphincter by several catgut sutures passing through the appendices epiploicae and the longitudinal muscle band.

In America, J. B. Murphy[715] presented his method of rapid anastomosis by the aid of a metal button. He, as well as others, notably Marcy, Mayo, Hartmann and McBurney, employed it in low sigmoidal growths. Shortly thereafter, Giordano[401] performed an abdominoperineal excision without preliminary abdominal colostomy. In 1897, Quénu[825] followed Czerny's example of rectal extirpation but preserved the sphincter muscles. Here, a circular incision was made through the skin surrounding the anus with dissection upward inside the sphincter muscle for a distance of one-quarter inch. A strong ligature was tied around the cylinder thus formed to serve as traction. The anus was cauterized and the external sphincter incised anteriorly and posteriorly in the midline, the latter being carried to the coccyx, which was usually removed. The rectum was dissected free up to the peritoneum, which was opened to permit descent of the bowel. Following closure of the peritoneum, the rectum was amputated above the growth, and the proximal end sutured to the skin. The procedure was well received, and in 1903 was modified by Tuttle,[1000] and adopted by such eminent surgeons as Abby and C. H. Mayo, who employed it in preference to the sacral method. With the turn of the century, Cripps[219, 220] advocated a procedure not unlike that of Allingham, whereby the main fibers of the external sphincter were preserved.

An early reference we have found similar to the procedure which is now termed "proctosigmoidectomy" is that by Archibald,[21] of Montreal. In 1905, he performed an unusual type of operation which was reported three years later. He gives credit to Kummell,[573] De Quervain,[281] and Treves[973] for having performed it previously. The patient in question had been given an inguinal colostomy for tuberculous proctitis; then, because of narrowing of its orifice, he mobilized and excised the rectum and sigmoid and transplanted the descending colon into the anus to preserve the sphincter function. The patient died of shock, but postmortem examination disclosed no impairment of circulation to the transplanted bowel. Thirty years later, Archibald[20] mentions that he discontinued the procedure because of circulatory impairment to the bowel. Only the one case was cited, however. In 1908, Lockhart-Mummery[624] excised the pelvic sigmoid and established continuity over a glass or rubber tube by end-to-end suture. He credits Morison for the procedure. Additional reports of the use of this technic were made by Balfour.[74, 75] Kuttner,[577] in 1910, reported a three-stage abdominosacral maneuver, while Morestin,[735] in 1918, reversed Hochenegg's procedure by removing the lining of the distal segment and spliced the bowel by pulling it up over the distal segment, where it was sutured. A few years later, Gant, in an effort to preserve the sphincter musculature, excised the anal skin, split the external sphincter anteriorly and posteriorly, and, after excising the growth, sutured the proximal end of the bowel to the skin. Thereafter, the anterior and posterior incisions and divided sphincters were approximated with catgut. Another reference to be found

on proctosigmoidectomy is that by Lockhart-Mummery,[610] who, in 1914, and again in 1923, described an alternate method of abdominoperineal excision to preserve sphincter function by bringing the stump of the sigmoid down and stitching it to the anus. A similar method of sphincter muscle preservation was also designed by Perthes[790] and Rayner[850].

Babcock,[29, 30, 37, 41] in 1932, described his experiences in a group of 30 cases and definitely established the fact that a pelvic diaphragm is not essential. He advocated the term "proctosigmoidectomy," or "over and under," which has served to popularize the procedure throughout the world. Modifications and additional data are available in his subsequent contributions.[27, 32, 33, 34, 38, 39, 42] The next decade brought forth various modifications of procedures already outlined. Cunéo, Sénèque and Zagdoun,[256] for example, modified their original method[255] by resection of the rectum through one ischiorectal fossa without sacrificing the hemorrhoidal nerves on the opposite side. Turner[997] performed a "pull-through" procedure, preserving the sphincter muscles for rectal growths, while Devine[286, 288] described his technic of telescopic anastomosis not unlike that presented by Lockhart-Mummery and Balfour. Lahey, an ardent critic of all methods to eliminate colostomy, reported three cases in which, following resection, establishment of colostomy and closure of the rectal stump, the splenic flexure was anastomosed to the rectal stump in order to avoid an abdominal stoma. In an effort to avoid colostomy, Lynch[635, 639, 641] modified the Cripps operation[249] and amputated the rectum by the perineal route, in which the bowel is divided at the level of the peritoneal floor, with no attempt at approximation and with sacrifice of the sphincter muscles.

Independently, under the title of abdominoperineal-sacral or anal excision, Berg,[100] Pannett,[779] Arnold,[23] Pratt,[819] Pack,[776] Bergeret and Livory,[102] Wilensky,[1053, 1054] Wangensteen,[1021] Mandl,[656] Murray[749] and Jenkins[498] describe their technic in one, two or three stages with preservation of the sphincter musculature. Horsley,[481] Wood and Wilkie,[1063] Babcock,[28] Fallis,[336] Arnold and Shea,[24] Wangensteen,[1021] Dixon and Dunphy,[297, 310] as well as Zinninger and Hoxworth,[1079] offer contributions to the literature in which the rectum, rectosigmoid, and lower sigmoid are mobilized and resected with immediate re-establishment of continuity by open or aseptic end-to-end anastomosis.

Methods of Surgical Extirpation

Proctosigmoidectomy. Indications. Proctosigmoidectomy may be employed for all operable cancers between the level of the midsigmoid and the low rectum.

Contraindications. Where the cancerous process involves the lowest six centimeters of the bowel (anal canal and lowest 3 cm. of rectum), preservation of the sphincter musculature is definitely contraindicated, and therefore proctosigmoidectomy is not recommended. Lesions in the middle third and upper third of the sigmoid are better treated by a single-stage or multiple-stage procedure alone through the abdomen. A growth in the low sigmoid may be removed by either an abdominal procedure, such as resection and immediate anastomosis, or by an abdominoperineal approach, namely, proctosigmoidectomy. Influencing factors as to choice are the depth of the pelvis, mobility of the sigmoid, presence of obesity, and the preference and experience of the individual surgeon. While proctosigmoidectomy is not contraindicated, it is quite an unnecessary maneuver unless pathology, such as polyposis or ulcerative colitis, involves the rectum, sigmoid and descending colon. In such an event, these portions of the bowel are mobilized, and by preserving the blood supply from the middle colic artery, the transverse colon is transplanted to the anus with removal of the diseased gut together with preservation of the sphincter muscles (see Transplantation of Transverse Colon to Perineum, Chap. 21).

ADVANTAGES. Proctosigmoidectomy is performed in one-stage, no colostomy is established, the radicability of the excision is in no way compromised and a complete pelvic diaphragm is avoided, which permits wider removal of the pelvic peritoneum. The bowel is delivered through the perineal wound by traction on healthy rather than on diseased tissue, so that the bowel is not crushed, opened or removed until all wounds are closed or occluded and dressings are in place. An immediate perineal anus is formed. An experience of eight years, during which period this method was *employed in a group of 401 patients with* cancer, gives evidence that the operative mortality is low, the period of morbidity diminished, and that the five-year rate of survival parallels and in some instances exceeds that with the Miles and other procedures. The incidence of local recurrence is low (*greater by less than two per cent,* using the exhaustive investigations of Gilchrist[309, 1101] for comparison). Sexual impotence in the male is decreased, anal sphincter muscle contraction returns to normal with adequate physiologic reflex, and natural reconstruction of the anal canal is achieved.

DISADVANTAGES. Only 80.3 per cent of lower bowel cancers (anus, rectum and rectosigmoid) are amenable to proctosigmoidectomy with retention of the sphincter muscles. *If lesions of the low sigmoid are* included, the percentage is increased proportionally. The selection of the arterial supply to be preserved must be accurate and precise, a difficult procedure for the novice. The preservation of the sphincter musculature is tedious, and the dissection and mobilization of the lower bowel through the small perineal aperture may be *somewhat difficult for the occasional* operator and may tend to interfere with wide division of the levators at a high level.

THE BLOOD SUPPLY TO THE BOWEL PERTINENT TO PROCTOSIGMOIDECTOMY. Of first importance to the success of this operation is the viability of the bowel to be brought *down to the anal skin. It is not, however,* a difficult task if one will assure himself by palpation and particularly transillumination of the adequacy of the vascular supply. In our clinic, observers constantly ask how this is accomplished, for which reason the subject is discussed in detail under Anat*omy, Chapter 1, pages 26 to 30.*

INCIDENCE OF CANCER IN VARIOUS PORTIONS OF THE RECTUM. If the sphincter muscles may be preserved in the presence of cancer above the lowest six centimeter level, it would appear appropriate to inquire concerning its incidence in various portions. *As cited in previous editions,* Group C disclosed a series of 1,995 cases in which the location was accurately noted in 1,401 instances. It is evident therefrom that only 10.2 per cent of lesions (4.9 and 5.3) occur *within the distal 5.5 centimeters of the* bowel (above the anal margin), and 19.1 per cent (4.9, 5.3 and 8.9) within the distal 8 centimeters. From this it may be deducted that 80.9 per cent of cancers, or those above this level, may be removed without sacrificing the sphincter muscles. Since our *interest is chiefly directed to the* distal six centimeters, from Group A the writer[1090] recently selected the case records of 180 consecutive patients for the purpose of comparison, the results of which are disclosed *in the appended table.*

From this table one may conclude that 19.7 per cent occur in the lowest 6 centimeters, whereupon, on the basis of com-

		Location	No. Cases	Percentage
		Sigmoid	23	12.8
80.3%	33.8%	Rectosigmoid	53	29.8
	46.5%	Rectum (excluding lower 3 cm)	73	40.2
	19.7%	Anal canal (including lowest 3 cm. of rectum)	31	17.2
	100.0%		180	100 0

bined pathologic studies, it may be deduced that only in this proportion of cases (19.7%) is sacrifice of the sphincter muscles definitely indicated.

Mandl,[657] in 1922, observed that of 461 operations for cancer of the rectum, the sphincters were retained in 227 cases and concluded, "Whenever possible, in situations where the tumor is a sufficient distance from the sphincters, these should be preserved." It may be mentioned that of the 638 resections in Group A, 473, or 74.3 per cent, were performed without permanent colostomy and 435, or 68.3 per cent, without any type of colostomy.

Abdominoperineal Proctosigmoidectomy without Colostomy and with Preservation of the Anal Sphincter Muscles. TECHNIC. ABDOMINAL PHASE: The abdomen is opened through a left oblique Babcock incision three centimeters above the inguinal ligament, beginning at a point to the right of the midline above the pubic spine and ending medial to the left anterior superior iliac spine. Ordinarily, the left anterior rectus sheath is divided, and, in a few instances, we have detached both the rectus and pyramidalis muscles from the pubic spine, as suggested by Cherney. More recently, we have returned to the classical left paramedian incision. The liver is examined for metastasis; the median lumbar, upper and lower mesocolic areas palpated for nodules, and the extent of the growth determined. The patient is placed in the exaggerated Trendelenburg position, and the pelvic cavity is cleared of small intestine by hot packs. A single catgut suture is temporarily introduced between the edge of the incised peritoneum close to the bladder and the fascia in order to elevate the peritoneum and thus prevent its dropping down during mobilization (McNealy stitch). The left lateral leaf of the mesosigmoid is freely divided wide of any malignant infiltration, the incision being carried downward to the rectovesical or recto-uterine sulcus. In the course of the dissection, the left ureter, the iliac and the spermatic or ovarian



FIG. 493 B. G. J., age 45. Abdominoperineal proctosigmoidectomy. This specimen shows two lesions, one immediately above the rectosigmoid and the second in the ampullary portion of the rectum (both Grade II).

vessels are exposed. The spermatic or ovarian vessels may be divided and ligated. The sigmoid with attached fat and mesosigmoid is mobilized toward the midline as far as the aortic bifurcation, thus clearing all gland-bearing areas in the vicinity of the iliac vessels. Routinely the incision in the left lateral gutter is continued upwards along the descending colon to permit additional mobilization. The peritoneum on the mesial side of the sigmoid is incised downward, continued around the right pelvic brim and across the sulcus between the rec-

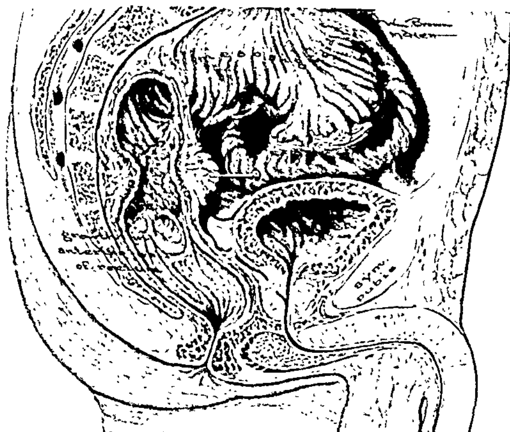


Fig. 494. Sagittal section showing carcinoma of rectum.

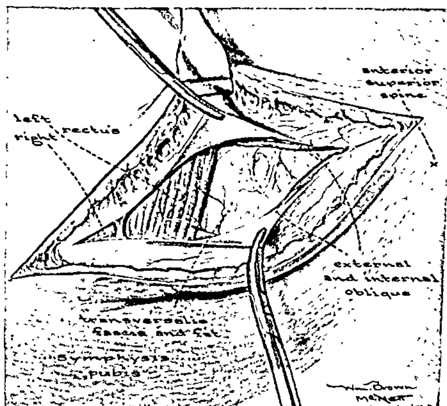
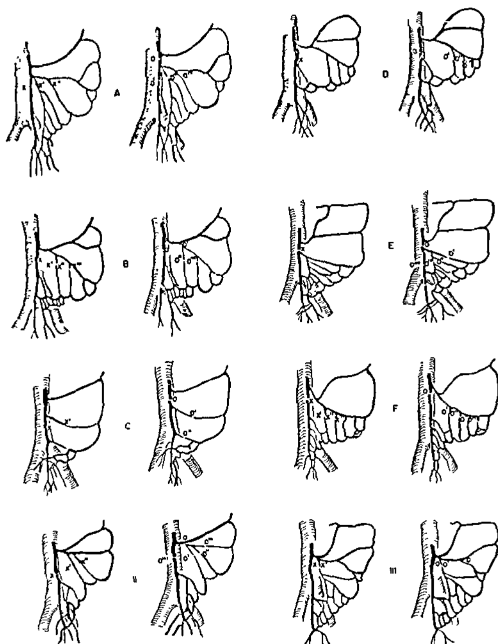


Fig. 495. Diagonal incision in the left lower quadrant of the abdomen parallel to Poupart's ligament.

PLATE 10



Drawings, of the aorta, the common iliac arteries, the inferior mesenteric artery, the left colic artery, the sigmoidal arteries and the superior hemorrhoidal artery in each of eight patients (A, B, C, D, E, F, II, III). The preferred and acceptable alternate points of ligation of the inferior mesenteric and sigmoidal arteries are indicated by X, X′, X″, X″′, and O, O′, O″, O″′ respectively. The points also outline that portion of the sigmoid mesocolon and lymph gland bearing tissue which will be removed during the perineal phase of the operation. The route of the preserved blood supply to that portion of the bowel which is to be transplanted to the perineum is denoted by red. The interrupted arterial pathways are indicated by blue. (H. E. Bacon and C. H. Smith: Ann. Surg. **127**:28.)

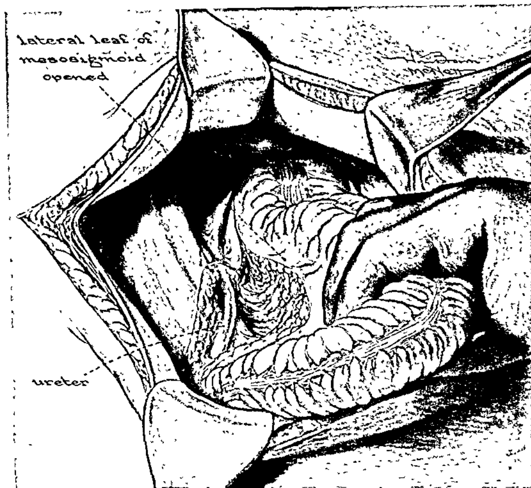


Fig. 496. Mobilization of the sigmoid begun by incision of the lateral leaf. The ureter is identified and retracted.

tum and bladder or uterus to meet its fellow of the opposite side.

By gently inserting the hand into the postrectal cellular space in the pelvis, the lower pelvic sigmoid and rectum can be stripped from the anterior surface of the sacrum as far as the sacrococcygeal articulation. The lateral ligaments are rendered prominent and divided. They may or may not require ligation. Anteriorly, the rectum is separated in the female from the upper and middle portions of the vagina, and in the male from the base of the bladder as far as the prostate. Care should be exercised to avoid injury to the seminal vesicles and vas deferens.

Ordinarily, transillumination is employed to visualize the inferior mesenteric, superior hemorrhoidal and sigmoidal vessels and their communicating arcades. By such, greater precision can be exercised on those to be preserved, which is essential for that portion of the sigmoid to reach through the anus. The necessary vessels are clamped, divided and doubly ligated.

The arterial supply has been discussed in detail under Anatomy (see page 26).

The ligature is usually placed between the first and second sigmoidal branches. The point of viability is determined by observing pulsating arteries or by the character of the bleeding when the small vessels on the surface of the bowel at the level of resection are incised. Two and one-half grains of sulfanilamide powder are dusted over the viscera, which are covered by the

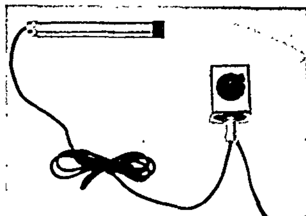


Fig. 497. Transilluminator for identification of sigmoidal vessels.

great omentum. More recently, we have employed 100,000 units of penicillin also. The peritoneum may be closed with a continuous suture of No. 0 chromic catgut and the fascia with interrupted sutures of No. 32 alloy steel wire and skin with No. 35 wire, although we prefer figure-of-eight wire suture, after the method of Smead.

Perineal Phase. *Step 1.* The patient is changed to the lithotomy position on the specially designed spinal mattress and the rectum packed loosely with colorless antisepticized gauze.

Step 2. The anal margins are clamped precisely in four divergent quadrants with *Pennington hemostats and retracted (Fig. 500).*

Step 3. A circular incision is carried just through the anal skin (squamous epithelium) one-eighth inch distal to and below the anorectal (pectinate, dentate) line (Fig. 502).

Step 4. The edges of the proximal incised skin are held taut, and from them is teased

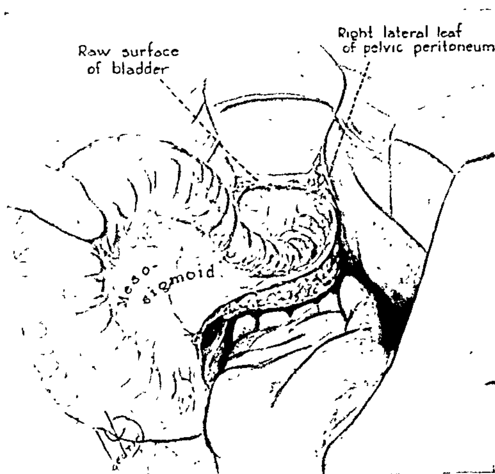
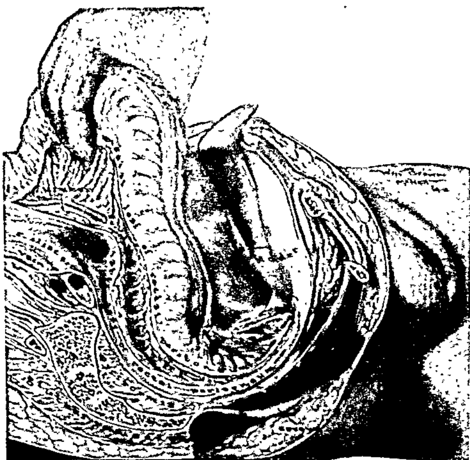


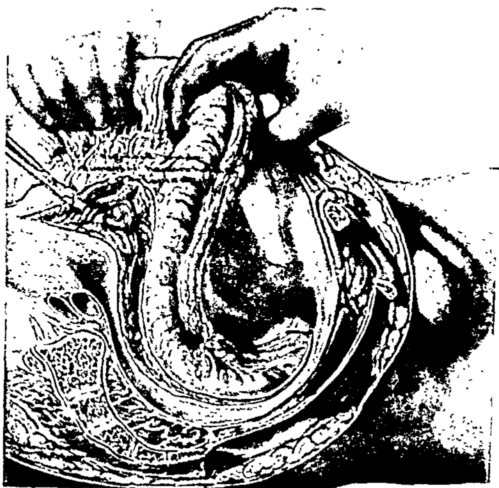
Fig. 498. Hand of operator introduced into pelvis separating rectum from sacrum.

PLATE 11



After small intestines are displaced from operative field by means of packs, mobilization of the sigmoid is begun. The left lateral peritoneal leaf has been incised to expose ureter. This incision is joined behind the base of the bladder by an incision in the mesial leaf of the peritoneum. (H. E. Bacon· Surg., Gynec. & Obst. 81:116.)

PLATE 12



Ligation of inferior mesenteric vessels. (H. E. Bacon: Surg., Gynec. & Obst. 81:117.)

PLATE 13



Mobilization of the bowel posteriorly is accomplished by gentle but firm introduction of the hand into the presacral space as far as the sacrococcygeal articulation. Anteriorly, the rectum is dissected from the vagina, or to the prostate. (H. E. Bacon: Surg., Gynec. & Obst. 81:120.)

PLATE 14



Schematic drawing showing incision of both peritoneal leaves, 1 and 2. From the abdominal phase the rectum is shown mobilized anteriorly as far as the prostate 3, or the vagina and laterally to the levators, b. From the perineal phase, the dissection is continued from a to a1 to and through b. (H. E. Bacon: Gynec. & Obst. 81:121.)

the surrounding musculature by sharp and blunt dissection. This muscle—the subcutaneous bundle of the external sphincter—is readily prominent, while medially the lower margin of the internal sphincter is evident. Briefly stated, retraction of the anal margin has partially displaced and stretched this musculature, but the anatomic relationship remains unchanged. A review of the sagittal section on page 12 and page 42, will disclose the fact that the internal sphincter muscle descends for approximately two-thirds of the length of the anal canal and is separated from the external sphincter below (subcutaneous bundle) by the intersphincteric line, perhaps better termed the "intermuscular septum." The initial incision which is made immediately below the anorectal line becomes displaced, by virtue of the retraction. It is relatively easy to separate and introduce a small retractor into this septum between the internal sphincter medially and the subcutaneous bundle situated below and laterally. This must not be done, because the internal sphincter would be sacrificed. Instead, both the subcutaneous bundle of the external sphincter and the internal sphincter are dissected free and retracted gently about the entire circumference.

Step 5. The four Pennington clamps used to retract the anal margin are discarded and fresh ones applied coronally to the gut edges of the bowel in a fashion that will occlude the lumen. These clamps are held together with a stout rubber band and drawn taut.

Step 6. The dissection is carried cephalad between the thin rectal wall medially and the internal sphincter laterally until the increment or body of this muscle becomes thinned, or to where it continues above as the circular coat of the rectum.

Step 7. At this point the circular muscle is pierced and the longitudinal muscle divided together with a portion of the fibromuscular ring in order to enter an ill-defined cleavage plane between the levator muscle situated medially and above, and the deeper portions of the external sphincter (superficial bundle and profunda bundle) below. Thus are the Pennington hemo-

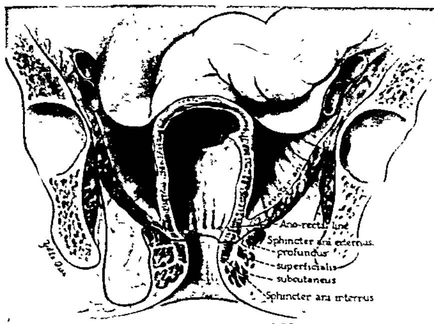


Fig. 499. Diagram showing degree of excision with preservation of internal sphincter and three bundles of external sphincter.

stats clamped to the rectal wall with attached levators for sacrifice, while the three bundles of the external sphincter and the internal sphincter have been separated for preservation.

until the depth of the abdominal dissection is encountered. The seminal vesicles and vas deferens are again visualized. In the female, the rectovaginal septum is separated by blunt and gauze dissection until the

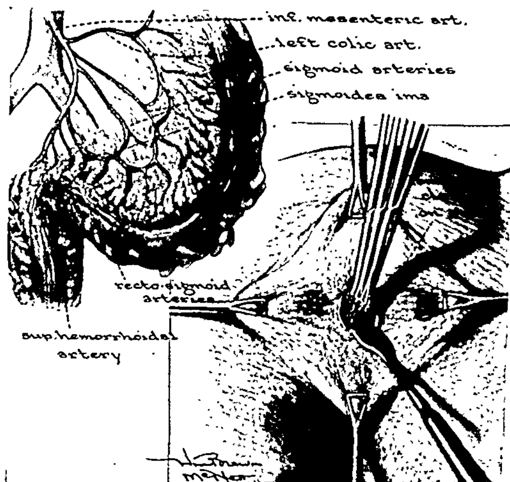


FIG. 500. (*Top*) Arterial pattern of mesosigmoid. (*Bottom*) Eversion of anal margin with displacement of anal epithelium. Circular incision has been made at anorectal line. Edges of bowel have been clamped.

Step 8. Richardson retractors holding the musculature to be preserved are sharply angulated into the ischiorectal fossa to permit wide removal of the fat therein.

Step 9. Posteriorly, a single transverse incision through the fascia propria, which is closely adherent to the periosteum of the coccyx, is all that is needed to mobilize the rectum.

Step 10. Anteriorly, the superficial and deep transverse perineal muscles are retracted and the line of cleavage cautiously followed between the rectum and prostate divided portion above is reached. Mobilization has now been effected posteriorly and anteriorly.

Step 11. By making traction on the bowel, the levator muscles are placed on the stretch, provided, of course, the lateral ligaments were divided during the abdominal phase. The levators from front to back are clamped high and wide with large curved hemostats. They are then divided, and ligated (Fig. 504, p. 744).

Step 12. Mobilization being complete, the rectum and lower sigmoid are drawn

through the wound and enclosed in a sterile towel. The segment of viable bowel must protrude well beyond the anal margin.

Step 13. The pelvis is inspected for bleeding points and an anterolateral pelvic floor is established by introducing two or three catgut sutures through the edges of the peritoneum. Occasionally this closure is made from the abdominal phase, although in our experience with 434 cases, the approximation effected is more precise from below. At no time is it advisable to place sutures between the peritoneum and the bowel, although it is permissible to tack the fat tabs to the edges of the peritoneum.

Step 14. One or two alloy steel wire sutures are placed interruptedly to approximate the stumps of the excised anterior levators. The sphincter muscles, which have not been incised or divided in any phase, are permitted to assume their normal position.

Step 15. A curved, perforated, metal drain is inserted posteriorly along the sacrum to evacuate blood and serum during the first 24 hours (Fig. 508 A). A slit-dressing saturated with tincture benzoin is applied. The extruding bowel is slit at a point seven centimeters from the anal margin to allow for retraction (Fig. 508 B), and the bleeding points are ligated at this level. A mushroom catheter is inserted into the lumen of the bowel to a point above the new pelvic diaphragm and held in place by the Daniel's clamp[204] (Fig. 508 C). The metal drain is removed at the expiration of 24 hours. Irrigation of the bowel through the catheter is begun the morning after operation, using a few ounces of warm saline solution, at four-hour intervals. It is continued until the time of the first satisfactory evacuation, which is usually the

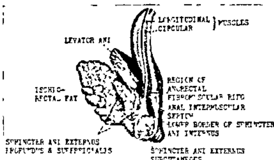
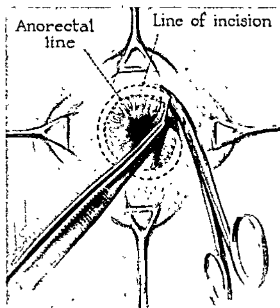


Fig. 501. Vertical section of anal canal. (E. T. Milligan and C. N. Morgan: Lancet 2:1150.)



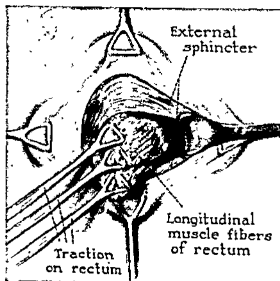


Fig. 502. (*Top*) Circular incision carried immediately below anorectal line with fine scissors.

Fig. 503. (*Bottom*) Bowel has been clamped; subcutaneous brindle of external sphincter has been retracted. Superficial and profunda bundles are yet to be dissected and retracted.

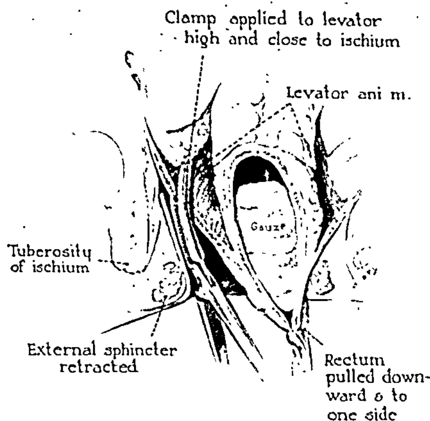


FIG. 504. Application of curved clamp on levator at high level. Note position of clamp in relation to tuberosity as well as location of retracted sphincter muscle.

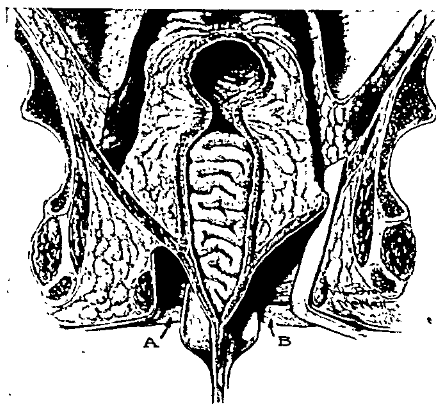


FIG. 505. (A) Sphincter muscle bundle has been retracted by small clamp. (B) Division of levator to point of mobilization from above.

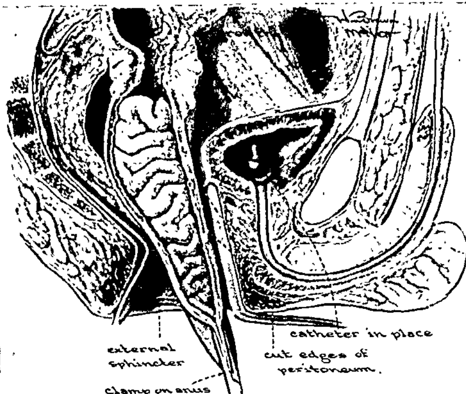
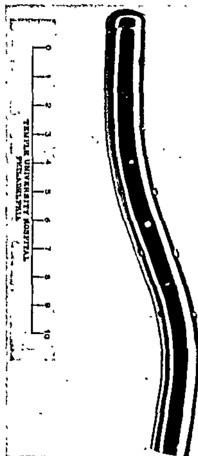


Fig. 506. Sagittal section showing clamped rectum containing gauze packing. Bowel is placed on stretch during anterior mobilization.

third day. The clamp is then removed and the catheter withdrawn.

Bowel Stump. *Management of Redundant or Protruding Bowel Stump.* The portion of the bowel distal to the Daniel's clamp will slough off because of pressure necrosis. In a few instances the protruding gut will retract to the anal margin and become adherent to the anal epithelium. Ordinarily the patient is taken to the operating room on the seventh or eighth day, the bowel is removed, and the edges are meticulously sutured to form a new anorectal line.

Technic. Using the jackknife position with the patient under sodium pentothal or spinal anesthesia, the anal skin, which has become puckered and rolled, is teased from the bowel, gently mobilized and retracted. The gut is drawn taut and a Payr clamp placed coronally about the bowel, which is excised with the Paquelin cautery. The



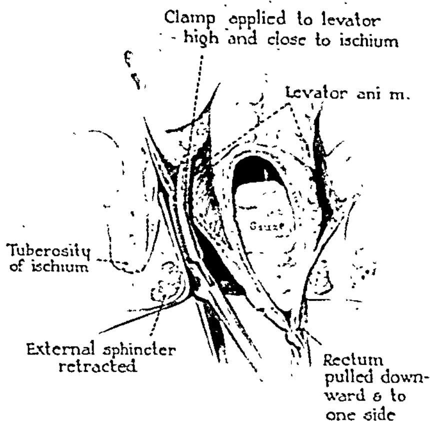


FIG. 504. Application of curved clamp on levator at high level. Note position of clamp in relation to tuberosity as well as location of retracted sphincter muscle.

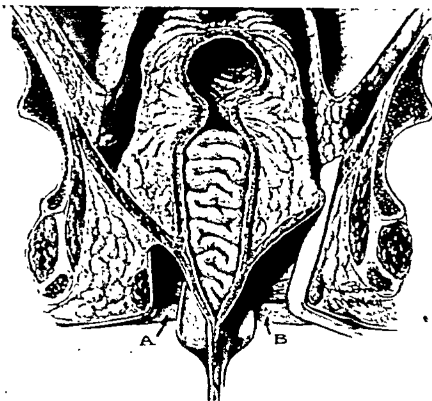


FIG. 505. (A) Sphincter muscle bundle has been retracted by small clamp. (B) Division of levator to point of mobilization from above.



FIG. 509. W. Daniel clamp (Am. J. Surg. 71:103)



FIG. 510. Photograph of mobilized cancerous bowel being drawn through anal aperture.



FIG. 511. Mrs. E. C., age 66. Adenocarcinoma, Grade II, of midrectum, diabetic. A proctosigmoidectomy was performed without colostomy and with sphincter muscle preservation. The patient was out of bed on the fourth postoperative day, and discharged from the hospital the eleventh postoperative day. (Referred by Dr. Wendell Burkett.)

Temporarily, attention is directed to the levators, which, by traction, are placed on tension. These muscles are clamped high from in front backward, divided and ligated. The peritoneum is opened with scissors and the incision carried around the peritoneal pouch; the lateral ligaments are encountered, and these are divided with or without ligation. Posteriorly, a single transverse incision is made through the fascia propria closely adherent to the sacrum, and the hand is introduced into the presacral space. Mobilization being almost complete, the rectum and sigmoid are withdrawn through the wound and enclosed in a towel. Long, thin retractors are introduced laterally and the pedicle of the superior hemorrhoidal vessels is clamped at a high level, divided and ligated. The additional bowel thus mobilized is drawn through the wound and viability confirmed. An anterolateral pelvic floor is established by suture, after which two, or at the most three, alloy steel sutures are inserted through the anterior levator stumps for support. The sphincters are permitted to assume their normal position, and a curved, perforated metal drain is placed in the presacral space. The catheter in the

to their normal location and tacked to the edges of the mucous membrane of the bowel using fine catgut in mattress fashion.

Perineal Proctosigmoidectomy without Colostomy and with Sphincter Muscle Preservation. INDICATION. *In poor risk* patients and those especially obese, this procedure may be instituted, provided the growth lies above the 6-cm. level and can be palpated by the examining finger. The mortality rate is especially low (4 per cent) but the five-year survival rate is *only 37.9* per cent.

TECHNIC. With the patient in the exaggerated lithotomy position, the rectum is packed with antisepticized gauze and the anal margins retracted in four quadrants with Pennington clamps. A circular incision is carried through *the anal skin* ⅛ inch distal to the anorectal line. By grasping the proximal edges of the bowel, the sphincter muscles are identified, separated and retracted. To this point the anal skin as well as the sphincter muscles have been preserved *without division in any site. The* lumen of the bowel is closed by Pennington clamps held together by a rubber band. Anteriorly, the superficial and deep transverse perineal muscles are included in the retraction. Cautiously the line of cleavage *between the rectum and prostate is fol*lowed until the seminal vesicles and the base of the bladder come into view. In the female, the rectovaginal septum is separated by blunt and gauze dissection until the peritoneal reflection is encountered.

*Sliding of the opposed peritoneal sur*faces on each other is quite characteristic.

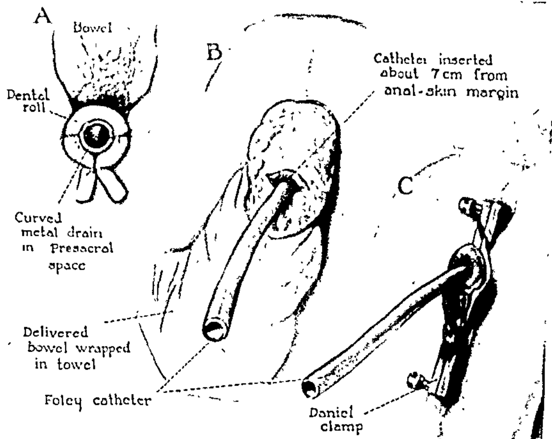


FIG. 508. (A) Bowel enclosed in sterile towel is elevated and held over pubis. Metal drain inserted in presacral space. (B) Bowel slit at a distance of 7 cm. from anal margin. Catheter introduced and Daniel clamp applied. Distal portion removed. (C) Daniel clamp holding Foley catheter in place.

	No. Cases	Deaths	Mortality Rate
Proctosigmoidectomy for cancer	401	20	4.9%
Proctosigmoidectomy for inflammatory stricture	24	0	0
Proctosigmoidectomy for diverticulitis	3	0	0
Proctosigmoidectomy for endometrioma of rectosigmoid	2	0	0
Proctosigmoidectomy for procidentia	1	0	0
Proctosigmoidectomy for kraurosis ani	1	0	0
Proctosigmoidectomy for benign lymphoma	1	0	0
Proctosigmoidectomy for megarectum	1	1	100
	434	21	4 8%

perineal extirpations, in which a large perineal wound is made, at least three months was the average period required for healing. Wangensteen[1023] has mentioned that from his experience with the abdomino-anal pull-through procedure, "the healing phase is longer and it is wise to make a complemental diversionary colostomy to afford rest to the pelvic colon pulled through the remaining distal sphincteric segment." The author takes issue with this conclusion, since in our series of rectal cancer there was but one instance in which a proximal stoma was instituted, and in this case a cecostomy was made prior to proctosigmoidectomy, solely to evaluate the rationality of decompression by inserting a Miller-Abbott tube through the stoma.

It is rather difficult to calculate accurately the date of discharge, especially with patients referred from distant cities who remain until transportation facilities are obtained. Table 73 shows the day the patient is permitted out of bed and the day of discharge in a group of 120 consecutive patients on whom an abdominoperineal proctosigmoidectomy was performed some three years ago.

Table 73

	Initials	Age	Sex	Type of Lesion	Day Out of Bed	Day Discharged Following Resection
1	M. B	66	M	Carcinoma	7	12
2	T D	55	M	Carcinoma	6	12
3.	M. L	59	M	Carcinoma	7	12
4.	G M.	55	M	Carcinoma	6	17
5.	J. B.	48	M	Carcinoma	8	11
6	E. O.	64	M	Carcinoma	7	12
7	J. W	57	M	Carcinoma	7	16
8.	E D	59	F	Carcinoma	6	12
9	P. K.	55	M	Carcinoma	6	12
10	L. M.	72	M	Carcinoma	8	14
11	L R.	52	M	Carcinoma	8	14
12	D M.	69	F	Carcinoma	6	14
13	F. W.	62	F	Carcinoma	6	11
14	E. McR.	63	M	Carcinoma	6	12
15	A S	70	F	Carcinoma	6	11
16	P. C.	39	M	Carcinoma	6	11
17	E R	42	F	Carcinoma	6	15
18.	W. O	52	M	Carcinoma	6	12
19.	T. C.	38	M	Carcinoma	8	13
20	T F.	69	M	Carcinoma	8	15
21	A. R.	72	F	Carcinoma	7	14
22	E N.	38	F	Carcinoma	10	14
23.	E. K.	68	F	Carcinoma	9	12
24.	E. E.	51	F	Carcinoma	13	19

bowel and the Daniel clamp are utilized in an identical fashion, as described under Abdominoperineal Proctosigmoidectomy (see p. 743).

Does Preservation of the Sphincter Musculature Augment the Operative Mortality? As one reviews the published reports on methods of resection for rectal growths in which the sphincters are retained (Table 72), it will be observed that the operative mortality compares favorab'y with other types of operation, such as the Miles (see p. 775, Table 78).

Over a 15-month period ending April, 1947, the author performed 145 consecutive resections without a single death. To the time of this writing (September, 1948), proctosigmoidectomy has been instituted in 434 patients for various conditions as indicated in the table at the top of page 749.

The cause of death in our 20 cancer cases is as follows:

Peritonitis	6
Pulmonary embolism	3
Myocardial failure	3
Cerebral thrombosis	3
Obstruction and pneumonia	1
Uremia	1
Diabetic coma	1
Hemolytic transfusion reaction	1
Anesthesia (autopsy)	1
Total	20 (4.9%)

How Does the Morbidity Compare with Other Methods of Resection? Patients following proctosigmoidectomy are permitted out of bed usually on the fourth or fifth day, and the majority have been discharged from the hospital on the eleventh postoperative day. It is worthy of mention that the presacral wound ordinarily consumes less than three weeks for complete healing and closure. Thus, the majority of our cases have been able to return to their former or perhaps lighter occupations in an average of from four to ten weeks following operation. In our other types of *abdomino-*

Table 72. Operative Mortality by Various Surgeons Performing Abdominoperineal Resections by Several Methods, in All of Which Sphincter Muscles *Were Preserved*

Author	Year	No. Cases	Resectability Rate	Mortality Rate
Hochenegg[450]	1909	320		13.7 %
Küttner[578]	1928		37 %	16.4 %
Sauerbruck[902]	1928		.	23 %
Graser[421]	1928		53 %	5.8 %
Kirschner[547]	1932	122	53 %	27 %
Pässler[783]	1935	67	44 %	35 %
Dietrich[291]	1928	364	64.3%	19.5 %
Payr[787]	1934		43 %	10 %
Finsterer[351]	1942	388	84 %	12 %
Oppölzer & Nitsche[1014]	1942	63	60.9%	6.3 %
Babcock & Bacon[45]	1943	414	93 %	6 6 % / 4 % perineal
Babcock[26]	1945	98 (last series)	97 %	4.08%
Mandl[655]	1946	.	66.7%	6.6 %
Murray, G.[749]	1946	15	...	6 6 %
d'Allaines[9]	1946	116	80 %	6.8 %
Ballivet[77]	1946	25	84 %	7 %
Nickel & Chenoweth[1060]	1948	68	...	13.2 %
Daniel[1090]	1948	24	...	0 %
Moon[1091]	1948	21	...	14.4 %
Fleming[1092]	1948	18	...	11.1 %
Waugh[1103]	1948	150	..	2 %
Bacon (Group A)	1948	401	87.7%	4.9 %

TABLE 73—(*Continued*)

	Initials	Age	Sex	Type of Lesion	Day Out of Bed	Day Discharged Following Resection
83.	E. L.	52	F	Carcinoma	7	13
84.	E. C.	68	F	Carcinoma	4	11
85.	M. K.	58	M	Carcinoma	6	18
86.	A. G.	54	M	Carcinoma	5	11
87.	G. K.	62	M	Carcinoma	5	11
88.	M. H.	67	F	Carcinoma	6	11
89.	B. C.	34	F	Carcinoma	6	11
90.	H. R.	52	M	Carcinoma	6	11
91.	M. M.	62	F	Carcinoma	6	12
92.	J. A.	66	M	Carcinoma	6	11
93.	H. L.	55	M	Carcinoma	6	11
94. (F)	C. B.	32	M	Polyposis with carcinoma	6	13
95.	H. A.	50	M	Carcinoma	6	11
96.	B. G.	35	M	Carcinoma	6	11
97.	D. P.	69	M	Carcinoma	6	12
98.	G. B.	62	M	Carcinoma	6	18
99.	L. S.	66	M	Carcinoma	6	11
100.	C. S.	58	M	Carcinoma	5	14
101.	C. T.	56	M	Carcinoma	6	12
102.	E. C.	40	M	Carcinoma	5	11
103.	W. M.	65	M	Carcinoma	5	11
104.	J. H.	67	M	Carcinoma	5	17
105.	C. M.	51	M	Carcinoma	6	18
106.	C. R.	54	M	Carcinoma	5	10
107.	A. C.	63	F	Carcinoma	5	11
108.	I. D.	49	M	Carcinoma	6	11
109.	E. C.	56	M	Carcinoma	6	15
110.	R. J.	58	M	Carcinoma	10	35
111.	M. S	65	M	Carcinoma	6	13
112.	M. D.	41	M	Carcinoma	5	14
113	T. M.	54	M	Carcinoma	5	11
114.	M. K.	35	F	Carcinoma	5	11
115.	E. S	59	M	Carcinoma	5	11
116.	M. F.	57	F	Sarcoma	6	13
117. (X)	K. C.	34	F	Carcinoma	6	12
118.	R. B.	39	M	Carcinoma	6	11
119.	J. C.	55	M	Carcinoma	6	11
120.	S K.	58	M	Carcinoma	6	11

Average time out of bed . 6 6 days
Average time of discharge after operation 13.4 days
F—Resection and transplantation of transverse colon to anus
X—Complicated by three months pregnancy

SELECTION OF CASES FOR PROCTOSIGMOIDECTOMY; EXTENDED RESECTION. The patients on whom proctosigmoidectomy was performed were selected by the same criteria governing any one-stage procedure, with two exceptions: (a) those growths involving the middle and upper third of the sigmoid (here some type of sigmoidectomy was performed), and (b) those growths in the lowest six centimeters of the bowel (here a Miles excision or colostomy and posterior excision were performed, due to the necessity of sacrificing the sphincter). After the method of David and Gilchrist,[270] we analyzed our cases (Group A) in which one or more factors clouded resectability. As evidence that the patients were otherwise unselected, the factors which may be considered to have extended the operative program are appended in the following table.

Table 73—(*Continued*)

	Initials	Age	Sex	Type of Lesion	Day Out of Bed	Day Discharged Following Resection
25.	J M	63	M	Carcinoma	8	13
26	B M	52	F	Carcinoma	9	13
27.	M. L	32	F	Carcinoma	9	12
28	F T	52	M	Carcinoma	8	13
29.	G W	60	M	Carcinoma	9	15
30	C B	54	M	Carcinoma	10	17
31.	A H	62	F	Carcinoma	9	15
32	R F	52	F	Carcinoma	11	21
33.	G B	56	F	Carcinoma	10	18
34	C R	44	M	Carcinoma	9	12
35	S P	55	M	Carcinoma	8	12
36	M M	29	F	Carcinoma	8	11
37.	V P	58	F	Carcinoma	10	16
38.	H S	51	M	Carcinoma	8	15
39.	A H	64	M	Carcinoma	9	19
40	M. M	62	M	Carcinoma	7	12
41.	M T	46	F	Carcinoma	7	18
42.	A. S	70	F	Carcinoma	9	20
43.	G. W	70	M	Carcinoma	9	22
44.	A V	64	F	Carcinoma	6	11
45.	J C	55	M	Carcinoma	6	11
46	M R	52	F	Carcinoma	6	11
47	S K	58	M	Carcinoma	6	12
48.	A McF	73	M	Carcinoma	9	18
49.	S S	64	F	Carcinoma	6	11
50.	W. H	41	M	Carcinoma	6	11
51.	W G	66	M	Carcinoma	6	12
52.	L K.	35	F	Carcinoma	6	11
53	L. L	41	F	Carcinoma	6	11
54.	H. T.	32	F	Carcinoma	6	11
55.	A. DeG	68	M	Carcinoma	9	19
56.	J. F.	45	F	Carcinoma	6	11
57.	G. G.	61	F	Carcinoma	6	12
58.	C. B.	61	M	Carcinoma	16	30
59.	A. K.	57	F	Carcinoma	6	12
60.	W. J.	35	M	Carcinoma	7	11
61.	R. B.	58	M	Carcinoma	6	11
62.	J. H.	56	F	Carcinoma	7	15
63.	H. T.	32	F	Carcinoma	6	11
64.	J. D.	55	M	Carcinoma	6	11
65.	W. H.	41	M	Carcinoma	6	11
66.	S. S.	64	F	Carcinoma	6	11
67.	L. M.	42	M	Carcinoma	6	11
68.	L. R.	49	F	Carcinoma	6	12
69.	G. C.	65	F	Carcinoma	6	24
70.	F. S.	53	F	Carcinoma	6	10
71.	L. C.	57	F	Carcinoma	6	11
72.	F. H.	69	F	Carcinoma	5	11
73.	A. T.	66	M	Carcinoma	6	11
74.	M. S.	54	M	Carcinoma	6	11
75.	C. D.	29	M	Carcinoma	6	11
76.	A. B.	72	M	Carcinoma	6	11
77.	C. H.	36	M	Carcinoma	6	13
78.	N. H.	46	F	Carcinoma	5	11
79.	A. T.	42	F	Carcinoma	5	11
80.	J. O.	70	M	Carcinoma	5	12
81.	M. K.	59	M	Carcinoma	5	11
82.	M. W.	60	F	Carcinoma	6	14

PLATE 15



(*Top*) C. R., age 52, male. Adenocarcinoma, Grade II C. Specimen shows a large carcinomatous process. Removed by abdominoperineal proctosigmoidectomy without colostomy; sphincters preserved. (*Center, left*) Abdominoperineal proctosigmoidectomy; no colostomy, sphincters preserved. (*Center, right*) Specimen removed by similar procedure. (*Bottom, left*) R. B., male, age 57. Adenocarcinoma, Grade II B. Abdominoperineal proctosigmoidectomy without colostomy; sphincters preserved. (*Bottom, right*) D. McG., age 56. Adenocarcinoma, Grade II B, same procedure.









TABLE 74. FACTORS WHICH OBSCURED RESECTABILITY (GROUP A)

Involvement of small bowel (resection in all)	7		
Bladder (partial cystectomy)	7		
Uterus and adnexa (removed in all)	17		
Appendectomy	4		
Vagina (wide posterior wall excision in all)	19		
Ureter (partial resection in all)	4		
Cholecystectomy	1		
Abdominal parietes (wide excision)	2		
Prostate (partial or complete resection in all)	10		
Urethra—partial	7		
	71		71
Liver metastasis		45 (11.2%)	
Age—70 or over		36	
Fixation to sacrum		9	
Transplantation of transverse colon to anus with resection		5	
Transplantation of colostomy to perineum with resection		10	
Adiposity		17	
Diabetes		11	
Asthma		5	
Bronchiectasis		5	
Severe coronary disease		8	
Double malignancy of rectum and sigmoid		19	
Multiple polyposis		4	
Concurrent adenocarcinoma with chronic ulcerative colitis		2	
Concurrent adenocarcinoma with inflammatory (L.V.) stricture		1	
Pregnancy (during gestation)		2	
Pregnancy (operation during postparturient period)		3	
		182	182
		Total	253

It may be mentioned that these are included in our entire group of 401 proctosigmoidectomies, for which the mortality rate was 4.9 per cent.

DOES PRESERVATION OF THE SPHINCTER MUSCULATURE COMPROMISE RADICABILITY? This question has been discussed at length in the foregoing pages and does not require repetition here. From the available evidence at hand, it would seem pertinent to conclude that preservation of the sphincter musculature does not compromise radicability so long as close adherence to the criteria for resectability is maintained. As Dixon[1110] recently stated "the efficacy of any surgical procedure for cancer is judged by the number of persons alive five years or more and not on an anatomic basis—the extent of the excision." It may be mentioned that Dixon (see p. 824) has observed a far greater incidence of both five (67.7 per cent) and ten (49.8 per cent) year cure with preservation of the sphincters (sigmoidectomy) than all available data recorded by the critics.

DOES PROCTOSIGMOIDECTOMY COMPROMISE RADICABILITY? Another phase to be considered, aside from preservation of the sphincter musculature, is that based on the question, Does this procedure permit wide surgical removal of the gland-bearing areas? In discussing this problem, one must be mindful that any method, independent of type, may be employed radically or conservatively according to the individual surgeon.[1091] This fact is clearly evidenced by the variations of technic in the performance of the customary Mikulicz procedure. The same may be said for the Miles type of excision, because many of us have observed over the shoulders of excellent surgeons

PLATE 15



(*Top*) C. R., age 52, male. Adenocarcinoma, Grade II C. Specimen shows a large carcinomatous process. Removed by abdominoperineal proctosigmoidectomy without colostomy; sphincters preserved. (*Center, left*) Abdominoperineal proctosigmoidectomy; no colostomy, sphincters preserved. (*Center, right*) Specimen removed by similar procedure. (*Bottom, left*) R. B., male, age 57. Adenocarcinoma, Grade II B. Abdominoperineal proctosigmoidectomy without colostomy; sphincters preserved. (*Bottom, right*) D. McG., age 56. Adenocarcinoma, Grade II B, same procedure.









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	71		71
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Transplantation of colostomy to perineum with resection		10	
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Diabetes		11	
Asthma		5	
Bronchiectasis		5	
Severe coronary disease		8	
Double malignancy of rectum and sigmoid		19	
Multiple polyposis		4	
Concurrent adenocarcinoma with chronic ulcerative colitis		2	
Concurrent adenocarcinoma with inflammatory (L.V.) stricture		1	
Pregnancy (during gestation)		2	
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		Total	253

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that no attempt is made to remove the levators. In fact, Mr. C. Naunton Morgan of London remarked that on a recent visit to this country, when he witnessed the performance of the Miles procedure in several of our larger cities, he observed utter lack of levator removal as an integral part of the operation.[1053]

Abdominoperineal proctosigmoidectomy *as it should be performed*[1102] *calls for and* permits wide excision of the mesosigmoid and all node-bearing tissue overlying the iliac vessels as far medially as the aortic bifurcation, wide removal of the pelvic peritoneum and a large expanse of mesorectum (perirectal tissue) with its contained nodes in the sacral hollow as well as the glands of Gerota, and finally, wide excision of the levators and the major portion of the ischiorectal fat. It has been reported that the usual point of ligation in performing the Gabriel (perineo-abdominal) and Miles (abdominoperineal) operations is 25 centimeters (10 inches) above the coccyx tip. In proctosigmoidectomy the point of ligation has averaged between 38 and 50 centimeters. *Such high point of ligation permits extended* removal of the mesosigmoid. In the Miles operation the average operator will conservatively divide the peritoneum in each gutter and especially in the pelvis close to the bowel, for the purpose of later establishing a diaphragm. In proctosigmoidectomy, greater removal is permitted, since no complete floor is made. By the same token, a few report utilization of the iliac sigmoid as a midline colostomy to extend the radicability of the Miles procedure. In proctosigmoidectomy, mobilization of this portion of the bowel (iliac sigmoid) and the lower descending colon is routinely made. Histolopathologic studies of the mesosigmoid and adjacent gland-bearing areas (upper mesocolic glands) in the presence of lowlying rectal growths, aside from those above, is sufficient evidence for wide surgical removal.



Fig. 512. S. S., age 56: adenocarcinoma, Grade II, B. Removed by proctosigmoidectomy.

Complications and Sequelae. The occurrence of complications incident to resection in general is discussed in Chapter 28, pages 1036 to 1062. It is our purpose, however, to consider those peculiar to proctosigmoidectomy.

Obstruction. The opinion is invariably expressed that intestinal obstruction should occur frequently, since no pelvic floor or diaphragm is established. As a matter of fact, Babcock[1082, 1083] reports that he has never encountered a single instance in his large series of cases, even though no pelvic floor had been established. In our series of cases (Group A), there have been several instances of obstruction, both dynamic and adynamic. One was fatal, an incidence of

where an abdominal colostomy was established because of a faulty or unsatisfactory perineal anus.[59] Suffice it to state that transillumination of the inferior mesenteric vessels and their communicating arcades together with precise palpation corrected quite simply this difficult problem.

Another annoying feature was the more than occasional infection occurring in the presacral space. In spite of drainage in this area, it became a requirement for our residents and nurses to introduce the sterile gloved finger at daily intervals until sitz baths were begun. In 1945, however, we found that division of the sphincter musculature, as previously instituted, was unnecessary, and, since no such division has been made, infection is practically nil.

Even with these corrective maneuvers, another deformity, which we have designated "Whitehead type of deformity," was encountered (Fig. 513 A). This was due to wide excision of the epithelium lining the anal canal, so that the mucosa of the mobilized sigmoid became clearly defined at the margin with the opening either too large or too small, either of which eventualities was distinctly objectionable. Applying in part the technic of skin preservation as it is done in hemorrhoidectomy, we found it possible to preserve and utilize the entire anal epithelium of the anal canal for replacement and reconstruction to normal (Fig. 513 F).

It should be mentioned that, in our early experience, the location of the anal aperture was occasionally either too far forward or too close to the coccyx. Where the sphincters are not divided, no such problem is offered, since the anal opening cannot but assume its natural place.

In retrospect, one can frankly state that refinements in technic have avoided these hazards.

Prolapse of the sigmoidal mucosa or mucous membrane still occurs occasionally. It is easily corrected by injections with phenol in oil or quinine and urea hydrochloride, or linear cauterization with the Paquelin cautery. Our preference is excision and suture, confining the patient to the hospital for two days. Perineal hernia was noted in one case which readily responded to approximation of the adjacent tissues by the perineal route.

One instance of persistent presacral sinus was encountered. Abdominal wound infection and dehiscence have been infrequent complications. In fact, in a group of 292 consecutive cases, there were three instances (1%) of wound infections. To a great measure, we believe this has been due to the use of sulfonamides, penicillin and streptomycin, to the maintenance of adequate protein and vitamin C levels and to the employment of the oblique muscle-splitting incision and Babcock's alloy steel wire. It should be added that, during a five-month period in 1948, three instances of dehiscence were experienced using a left paramedian incision with catgut suture for peritoneum and alloy steel wire for fascia on skin.

How Does the Survival Rate Following Proctosigmoidectomy Compare with Other Methods of Resection or Excision? It should be mentioned that Eiselsberg of Vienna, Sauerbruck of Munich, Payr of Leipzig, Mandl of Jerusalem, Gulede of Jena and Kirschner of Tubingen reported a slightly higher incidence of three-year and five-year cures where the muscles were not sacrificed. Similar published articles are to be found by Eichhoff and Pribram.

Only a small number of our patients can be evaluated for the period over five years, but the rate compares very favorably with other methods. The rates of resectability and mortality (previously cited on p. 748, Table 72) and the fact that resection was instituted for palliation as well as for cure should be noted.

By employing the method suggested by Newman of the British Ministry of Health[757] and by Dukes,[376] the five-year survival rate is computed from the customary fraction:

0.29 per cent. In this case, the small bowel descended into the presacral space and became obstructed, death occurring on the 10th postoperative day. Of the nonfatal cases, only four required surgical decompression, two during the first eight-day period, one at three weeks and one at two months. Of the four, the ileum had knuckled into the pelvis in three; in the fourth, the pelvic floor had been closed too tightly. All were later mobilized with subsequent closure of the stoma.

Sloughing of Protruding Bowel; Contraction of Anus (Stenosis), Wet Anus, Abnormal Location of Anus. It may be well to mention that our experience with this technic dates back a decade ago, when we first became impressed with the pioneer work of Babcock. Our early results were quite disheartening since, of five patients, three died of peritonitis as a result of absence of blood supply. (The two remaining are still living and well after eight and nine years, respectively.) The procedure was abandoned in favor of the more popular methods. However, over the ensuing period, the constant disfavor with which colostomy was regarded by patients and their frequent refusal to undergo surgery where an abdominal stoma was an integral part of the operation caused us to renew our experience with this method. Since it was evident that certain phases of the operation possessed merit, an organized plan of appraisal was instituted from an anatomic and pathologic as well as physiologic standpoint. A series of 71 cadavera were carefully dissected with especial attention to the collateral blood supply of the colon and rectum. The possibility of mobilization and "downswing" of the gut and the pararectal musculature was carefully investigated before the operation was again performed on the living. Even then complications were occasionally encountered. For example, sloughing of the protruding bowel occurred, leaving an angry, granulating, fibrous canal from which drained a mucopuruloid sanguineous material. Contraction of the anal margin developed, for which divulsion and posterior slitting offered little and only temporary benefit. Dribbling of feces was experienced, and the patient was compelled to change pads frequently. In a few instances the anal aperture subsequent to operation was found either too far forward or too close to the coccyx. In an effort to avoid these distressing complications and sequelae, we analyzed the situation to discover that the symptom-complex, namely, soiling, dribbling, etc., was due to incontinence brought about by contraction (stenosis). Further, we realized that this contraction resulted from the deposition of scar tissue due to infection. That the infection resulted from sloughing of the protruding bowel, which in turn was the result of inadequate viability in the distal segment of gut, was apparent. In other words, the direct cause was not so much the perineal portion of the operation as it was improper arterial supply to the bowel mobilized to the anus. Sloughing will not occur in the presence of viability unless gross infection exists in the presacral space, which is extremely uncommon. We know that occasionally the retained sphincter musculature may become too active and spastic to contract on the transplanted bowel and may thus strangulate the distal stump. This may cause the new anorectal line to be established higher than is normal. Attention has been called to the fact that the application of the perineal dressings too tightly or use of the metal drain presacrally may embarrass the blood supply to the stump. It should be mentioned that "sloughing" represents impairment of blood supply, whereas "retraction" is employed here to imply a normal sequence which occurs proximal to the site of the Daniel's clamp. We have encountered instances of slight retraction above the newly established anorectal line, but such are infrequent and offer no particular problem of management. At no time have we experienced sloughing of the bowel above the peritoneal floor level. In our entire series of cases there have been only

Percentage of Five-Year Survivals Conforming to Grade A

No. Cases	Died from Operation	Died Under 5 Years: of Other Causes	Died Under 5 Years: of Cancer	Untraced	Alive After 5 Years	Percentage of 5-Year Cures
20	1	2	1	2	14	93.3

Author	Grade	Cases Surviving Operation	Untraced	Deaths Due to: Cancer	Deaths Due to: Other Causes	Cases Surviving Five Years	Percentage Five-Year Survivals
Norbury[760]	A	21	1	2	2	16	88 x
Norbury[760]	A	10	0	0	3	7	100 xx
Lahey[584]	A	?	?	?	?	?	90 xx

x—perineal excision
xx—combined excision

Table 75. Permanent Colostomy Established

Author	Year Reported	No. Cases Resected	Resectability Rate	Mortality Rate	Percent Survival Five Years or More	Based on Cases
Rankin[837]	1933	300	50-68%	7.7%	38	.
Rankin[840]	1947	167	75.1%	5.3%	52.4	85
Lockhart-Mummery[622]	1934	340	. .	8 %	52	95
Jones, T.[513]	1935	127	79 %	11 %	52	. .
Jones, T.[511]	1947	535		3.7%	52	
Raiford[832]	1935	117	63 5%	23.2%	36	16
Abel[1]	1935			.	63.4	70
Jones, D F.[504]	1936	463		17.1%	55.5	
Brindley[156]	1937	76	52.4%	3.9%	63	.
Gabriel[376]	1937	100	.	22 %	52	
Miles[715]	1939	.	65 %	17 %	73	94
Lahey[581]	1939	.	88 %	10 %	42	
Pfeiffer[800]	1941	82	59 %	12.8%	45	.
Dixon[295]	1944		.	.	44-53	.
Gabriel-Dukes[307]	1944	514		15 %	44.9	.
Daniel[263]	1945		80 %	11 %	36	.
Daniel[1098]	1948	100	. .	4 %	.	. .
Hoxworth[487]	1947	167	59 %	14 %	33?	.
Hayden[456]	1945	131	91.2%	10 6%	33	32
Cattell[199]	1943	420	81.4%	10 7%	53.6	140
Cattell[199]	1943	168	. . .	6 5%	.	
Mayo[684]	1946	285		6.1%	55.8	133
Johnson[503]	1947	215	56 %	14.8%	36.8	. .

Attention is drawn to the difference in the resectability rates in 1933 and 1943, and the influence on the rate of survival.

Unfortunately, no statistics are available on rates of 10-year cure in our cases since none has passed this period. Attention is called to the table (p. 759) particularly the percentage of survival in terms of the com-

$$\frac{\text{Alive at five years} \times 100}{\text{Resection deaths less those untraced and those who died of other causes}}$$

Of 76 patients subjected to abdominoperineal proctosigmoidectomy five or more years ago, our incidence of survival (living *and well five years or more*) is *52.6 per cent.* It is interesting to note that the records of these 76 patients showed that the histopathologic reports in 20 instances conformed to Grade A (mural penetration). Of this number, 4 were Grade I, 15 were Grade II, and 1 was ungraded. It should be mentioned that this incidence of 52.6 per cent includes patients operated for palliation as well as for cure. At the time of reading the page-proof, the records of 93 patients upon whom this procedure was performed more than five years ago have been reviewed. Eight of this number showed evidence of liver metastasis at operation. The incidence of five-year cure including unfavorable cases—(glandular metastasis or local extension), and favorable cases—(no glandular metastasis or no local extension), but excluding those with liver metastasis, is computed at 58.4 per cent.

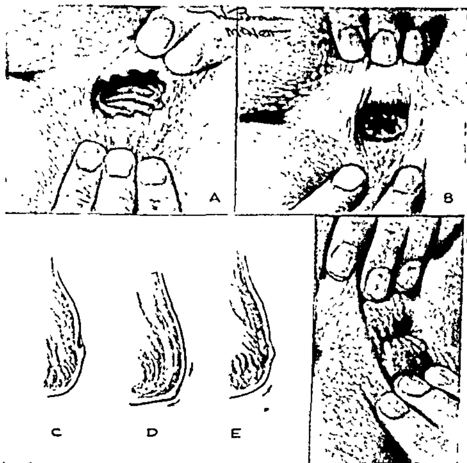


FIG. 513. (A) Incorrect insofar as the entire anal canal has been *sacrificed. Similar to Whitehead deformity. (B) Incorrect stenosis of* anus. (C) Correct point of incision to preserve anal skin. (D) Incorrect point of incision at lowest arrow. (E) Anal skin is finally elevated to establish normal anorectal line. (F) The illustration in the right lower corner shows the normal appearance following operation.

Available reports by various authors employing other methods where colostomy is established without sphincter muscle preservation are appended in Table 75.

Author	Year	No. Cases	Operation	Resectability Rate	Mortality Rate	Survival Rate 10 Years	Based on No. Cases
Rankin[847]	1933	300	Colostomy & posterior excision	58-68%	7.7%	24.1%	?
Colcock[233]	1947	234	Lahey or Miles excision	62.3 %	7.5%	23.2%* average 51.8%† 39.8%	125
Babcock[45]	1943	414	Proctosigmoidectomy	93 %	6.6%	19 %	100
Nickel & Chenoweth[1089]	1948	68	Proctosigmoidectomy	?	13.2%	26 %	23
Dixon[1113]	1948	426	Anterior resection	?	5.9%	49.8%* †	?

* Unfavorable cases (glandular metastasis or local extension).

† Favorable cases (no liver involvement, no glandular metastasis and no local extension).

patients with liver metastasis found at operation were excluded from their survey which is not true of those recorded by Babcock.[45] Also, in the article by Nickel and Chenoweth,[1089] the postoperative deaths were not excluded as is customary.

What Is the Incidence of Local Recurrence Following Abdominoperineal Proctosigmoidectomy? In our series (Group A), it will be noted that 76 patients were resected by this technic five or more years ago (see p. 756). It is known that 27 died of cancer, but, in reviewing their records, it was found that liver metastasis was present in four at the time of operation, so that quite properly these may be labeled "palliative resections" and therefore excluded from this calculation. In the remaining 23 nonpalliative cases, including both "favorable" (no metastasis to glands nor local extension), and "less *favorable*" (*metastasis to glands or* local extension), resection was instituted with the hope of cure. To estimate the percentage of recurrence, it is customary to subtract the number of deaths from operation and the number of palliative resections (*liver metastasis*) *from the total. The total* here of 76, less operative deaths (five), less palliative resections (four) divided into the remaining 23 cases gives an incidence of recurrence of 34.3 per cent. In this group of 23 cases representing recurrence, there were *12 instances where the recurrence* was "local." To estimate the percentage of these 12 cases of local recurrence, the number of deaths from operation (five) and the number of palliative resections (four) must be subtracted from the total, namely, 76. This represents a local recurrence rate of 17.9 per cent of the patients in whom resection was performed five or more years ago.

Since the efficacy of proctosigmoidectomy has been questioned, it was felt timely to determine the percentage of local recurrence, particularly in the immediate vicinity of the sphincter musculature. With all fairness it should be stated that at the time our early cases were operated upon by this technic—more than five years ago—we were less familiar with "local spread" than we are today because of the recent investigations of David and Gilchrist, Dukes and Coller, as well as Glover and Waugh. As a result we were less meticulous in measuring the lower border of the growth from the anal margin.

In reviewing the records of these 12 *patients presenting local recurrence*, my associate Dr. George Vaughan tabulated the location of the original growth, the gradation of the tumor and the extent of circumferential involvement as recorded in the following table:

Incidence of Recurrence

76 patients resected (proctosigmoidectomy) five years or more.

Number died of cancer	27
Number liver involvement at operation	4
Nonpalliative (favorable) and (unfavorable)	23
Incidence of recurrence	34.3%
Number local recurrence	12
Incidence of local recurrence	17.9%



Fig. 514. Appearance of the anal orifice following proctosigmoidectomy.



Fig. 515. G. M., female, age 40: abdominoperineal proctosigmoidectomy.

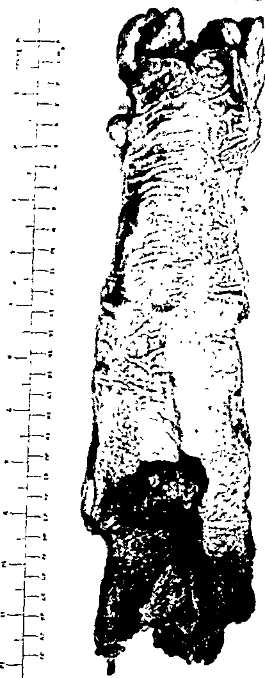


Fig. 516. L. C., female, age 57: *adenocarcinoma, Grade II B. This specimen* was removed by abdominoperineal proctosigmoidectomy without colostomy, and the anal sphincter muscles preserved.

parative resectability rates. Naturally, a resectability rate of 93 per cent could not give a comparative survival rate as a rate of 62 per cent. Further, in the group cited by Colcock[223] and the group by Dixon,[1110]



Fig. 519. M. A., specimen removed by proctosigmoidectomy.

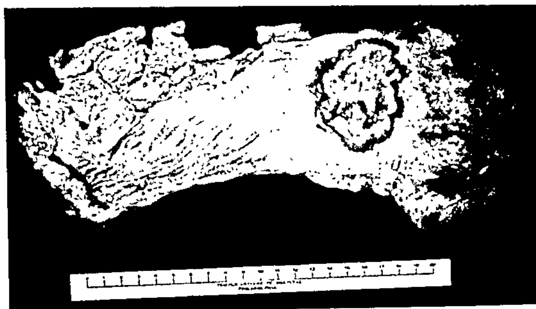


Fig. 520. H. W., specimen removed following proctosigmoidectomy.

currence after pull-through and I have yet to see a patient whom I thought would have been benefited more by the Miles procedure." Wangensteen has called attention to the observation that almost invariably the local recurrence has not been primarily at the site of anastomosis, but outside of it extending into the bowel secondarily, which suggests lateral invisible spread. In this view we concur, for which reason proctosigmoidectomy or any sphincter preserving technic is never employed when the lower border of the growth is at or below the six-centimeter level.

The subject of recurrent cancer and particularly local recurrence is interesting, but it presents a problem difficult of accurate evaluation.

In reviewing the literature in native and foreign tongues, one is impressed with the scarcity of published reports on recurrent cancer. As Webster states, "No one cares to write much on recurrence, for this admits at least partial failure and suggests incomplete operation, which may be permissible



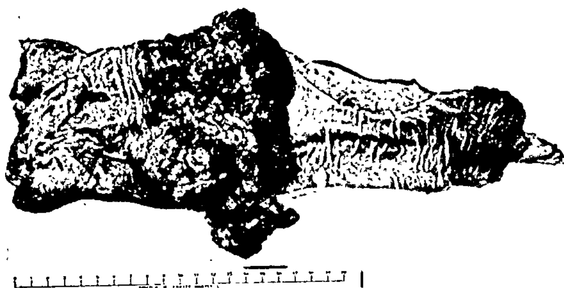


Fig. 517. (*Top*) C. V., female, age 64: adenocarcinoma. Abdominoperineal proctosigmoidectomy; no colostomy; sphincters preserved.

Fig. 518. (*Bottom*) C. T., male, adenocarcinoma Grade III; specimen following proctosigmoidectomy.

Grade I	0	
Grade II	8	
Grade III	3	
Grade IV	1	

Location:
- 1 at 7-8 cm.
- 2 at 9 cm.
- 1 at 10 cm.
- 1 at rectosigmoid

(Measured from anal margin)

- 5 at 4-6 cm.
- 2 at 6 cm.

(58.3% would not be done by this method—too low)

7 listed as circumferential
1 listed as ¼ (this was the grade IV on posterior wall)
2 listed as ½ (posterior wall)
2—location not specified

It should be stated that in seven cases (58.3%), the original growth was located at or below the six-centimeter level. In the light of our present knowledge these seven cases, performed more than five years ago, were incorrectly selected for sphincter muscle preservation. Waugh remarks, "I feel that the pull-through operation, when it is used for lesions above the lower one-third of the rectum, is just as curative as a Miles operation."—"I have re-operated practically every one of the cases I have seen with re-



FIG. 523. M. S., female, age 35: adenocarcinoma, Grade II C. Abdominoperineal proctosigmoidectomy; no colostomy; sphincter preservation.

six per cent. David and Gilchrist[350] report a rate of local recurrence of 16 per cent.

As one reviews the above reports, it becomes apparent that there exists marked variation, but of more import is the basis of estimation. Naturally, much confusion becomes manifest when effort is made to interpret and correlate such percentages. For instance, it is important to know the number of cases and whether all were resected. If so, were they resected for palliation or for cure, or for a combination of the two? What was the percentage of each? Were the operative deaths included or excluded in the final estimation? Further, it should be known whether the nonpalliative cases included those "favorable" (no glandular involvement nor local extension) and the "less favorable" (with glandular involvement or local extension) and, if so, the percentage of each. Were estimates of recurrence calculated on recent cases or in a group over a five-year period? It is known that recurrence manifests itself most frequently during the first three years following operation and is uncommon, although not a rarity, after the fifth year. Gabriel and especially Webster[1032, 1033] have discussed this at length.

Other questions to consider are: What is the ratio of recurrence? and, more specifically, What is the percentage of local recurrence? A few published reports are available from which one may attempt to correlate the contained data in an effort to arrive at a relatively accurate evaluation.

Lockhart-Mummery,[622] for example, reported a group of 230 resections for rectal cancer, which were operated upon five years or more previously. One hundred died of recurrence, so that the estimated recurrence rate is 43.4 per cent. Whether this is local recurrence is not stated; besides, no mention is made of deaths from operation. Quite recently, Lynch and Hamilton[640] analyzed 50 cases resected more than five years ago. Recurrence was noted in 16 instances, 12 of which showed the recurrence to be local. Lynch makes the statement that it is the rule for local recurrences to predominate in all types of operation for cancer at or about the rectosigmoid, and in a previous article he mentions that a study of 500 of his patients operated upon by the combined method revealed that 70 per cent of the recurrences were local. In these 50 cases reported by Lynch and Hamilton, there were five operative deaths, so that by subtracting this fraction and dividing it into 16, the incidence of recurrence is esti-

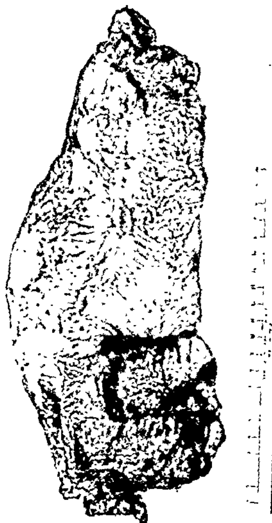


Fig. 521. Bowel specimen showing deep excavating ulcer.



Fig. 522. M. K., age 58. There is a craterlike ulcer in the rectum. Abdominoperineal proctosigmoidectomy was performed. The patient was out of bed the fifth day and was discharged the eleventh postoperative day.

for palliation but not if intended as a curative measure."

In the appended list is the percentage of recurrences as tabulated by various foreign surgeons.

Author	Per Cent Recurrence
Miles	29.5
Schneider (curative cases)	21.0
Rotter	27.8
Chaput (curative cases)	12.0
Schede	25.0
Lexer	25.0
Poppert	28.0
Mandl & Pacher	27.0
Pichler & Prutz	11.0
Davies	16.6
d'Allaines (resection)	7.0
d'Allaines (amputation)	29.0

As will be noted, little information can be gained therefrom. Nor is the following data very enlightening. For example, Peters and Calmer,[189] in a group of 30 cases, found recurrences to be 9 per cent in the cellular tissue, 50 per cent in the regional glands, 3 per cent in distant glands and 40 per cent metastasis to different organs. Hartmann,[419] in a series of 65 cases operated upon by the perineal route, noted 19 instances of recurrence, of which three were pelvic and two distant. In another group in which the same author utilized the combined operation, a recurrence rate of 44 per cent was cited. Berla[104] merely mentions 12 cases of local recurrence. Johnson[500] cites a recurrence rate of 39.4 per cent and Shallow[227]

tion which subsequently exhibits malignant change." The incidence of multiple malignancy has been discussed elsewhere (see p. 617).

What Degree of Continence Can Be Expected Where the Sphincter Muscles Are Preserved? Our confreres past and present have reported "satisfactory" results with their methods of sphincter muscle preservation. For example, Mandl,[654] an ardent advocate of the Hochenegg method, mentioned that of the cases in which circular suture was performed, 19.3 per cent of the patients were discharged as continent; complete control was effected after a period of time in 49.4 per cent. Following the "pull-through" method, the number of continent patients increased from 58.3 per cent to 64.5 per cent. In contrast, however, is the publication by Koerbl of the Eiselsberg Clinic, who observed complete continence in 36 per cent employing Hochenegg technic and 66 per cent with the Kraske method. Gersuny recorded satisfactory continence in 75 per cent of his cases. Du Pan, a pupil of Kocher, reported that eight patients had complete and 32 partial control; 11 were completely incontinent. A cursory glance will disclose that these results are far from ideal. Were these percentages of continence representative of our own cases today, the author would most certainly relegate proctosigmoidectomy, as a poor experiment, to the limbo of forgotten episodes of the past. It should be readily understood that anastomotic procedures of the upper rectum, rectosigmoid and lower sigmoid do not enter into this discussion, since, if they are performed through the abdomen, the innervation to the sphincter muscles is undisturbed. More than a decade ago our interest was drawn to the anal sphincter in infants by Dr. Ralph Tyson, then Professor of Pediatrics at Temple University. In many respects this experience of yesteryear has assisted in a better physiologic understanding of this muscle in adults. Indeed, the mechanism of continence has been a fascinating study that has resolved itself into a problem as yet unexplained in its entirety.

Our approach to the matter from an anatomic standpoint has improved the results to an unbelievable degree in so far as the musculature is concerned. In fact, by meticulous dissection the internal sphincter and the three bundles comprising the external sphincter muscle can be preserved in their entirety, and their subsequent contraction following resection would seem to be normal in every respect.[1103] This is true in the absence of certain sequelae, as outlined on page 753. As stated elsewhere, a viable bowel is essential.

Quite recently Gaston[1101] performed an interesting experiment on a few cases which bear influence on the subject at hand. This investigator defines sphincter continence as the retention of bowel contents by sphincteric contraction when the plastic adaptation of the colon reaches an end and peristalsis begins. It is his opinion that normal anal continence is the result of co-ordination between the rectum and the external anal sphincter; in other words, "the mechanism of sphincteric continence involves only the external anal sphincter and rectum." Gaston further mentions that sphincteric function following resection of the rectum may be lost by (1) injury to the somatic nerve supply (inferior hemorrhoidal), to the external sphincter, or where the levator muscles are divided lateral to the rectum, and (2) by destruction of the afferent fibers arising in the rectal wall.

We were of the belief that the innervation—namely, the inferior hemorrhoidal and perineal nerves, derived from the second, third and fourth sacral plexuses—was surgically intercepted during the perineal portion of the operation (proctosigmoidectomy), even though all bundles of the external sphincter were preserved; also that the small filament from the fifth sacral and coccygeal plexus—the lesser sphincterian nerve of Morestin—was intercepted. Yet Jerome Wagner[1098] of New York has demonstrated the somatic innervation to be intact macroscopically and microscopically

mated as 35.5 per cent, whereas the local recurrence rate (12 divided by 45) is 26.6 per cent.

Hayden,[455] in reporting 82 resections, cites 27 instances of recurrence, which, with the deletion of 11 operative deaths, gives a figure of 38 per cent. The number of local recurrences is not stated.

Colcock[233] recently reported a series of cases from the Lahey clinic in which, excluding those with liver metastasis, the combined groups of 73 patients (favorable) and 52 patients (unfavorable) totaled 125. If the 11 operative deaths are subtracted from the total, namely, 125, the remainder (114) when divided into the number of recurrences (54), shows an incidence of recurrence of 47.3 per cent. The rate of local recurrence is not stated.

Wangensteen,[1023] in evaluating the results achieved for carcinoma of the low pelvic colon and rectum (from 0 to 13 cm.) in which the sphincter muscles were preserved, observed a local recurrence rate of 13.7 per cent in the curative group, although all patients in the series had not been operated upon five years or more previously. The incidence of recurrence is summarized in Table 76.

It may be mentioned that David and Gilchrist[390] found a local recurrence rate of 16 per cent among their five-year survivors in whom the classical abdominoperineal excision of Miles had been performed. From this, Wangensteen concludes as follows: "The abdominoperineal operation—the most radical of the available curative operations—is also for certain cases an 'incomplete operation.'"

As a result of recent reports by various investigators, such as Swinton and Haug,[979, 981] Fischer,[352] Mayo and Schlicke,[686] Westhues,[1090] Norbury,[709] Gilchrist,[395] Lockhart-Mummery,[617] Hellwig,[462] Susman,[974] Berson,[104] Broad and the author[57, 58] the multiplicity of malignant lesions and the presence of associated adenomatous polyps have added new impetus to the study of recurrence. For this reason, more detailed examination prior to operation and at the time of exploration, especially in the removal of an extended portion of bowel, is instituted. Norbury[709] sums up as follows: "There is no doubt that a number of cases of so-called recurrence after operation are really due to the presence of another primary lesion—such a tumor may be a benign adenoma at the time of the original opera-

TABLE 76

Author	No. Resections	No. Operative Deaths	Per Cent Survived 5 Years or More	Recurrence (Type Not Specified) No. Cases	Recurrence (Type Not Specified) Per Cent	Local Recurrence No. Cases Local	Local Recurrence Per Cent
Lockhart-Mummery[622]	230 (performed five years or more previously)	?	52	100	43.4	?	?
Lynch & Hamilton[640]	50 (performed five years or more previously)	5	53.1	16	35.5	12	26.6
Hayden[455]	82	11	.	27	38	?	?
Colcock[233]	125 (performed five years or more previously)	11	47.5	54	47.3	?	?
Johnson[503]	38	7	36.8	15	39 4	?	?
Gilchrist & David[390, 1104]	112	12	51.8	35	31.2	18	16
Where sphincter muscles are preserved:							
Wangensteen[1075] (abdomino-anal pull-through)	63	..	...	...	...	7	14
D'Allaines & Vernejoul[1116]	.	..	...	...	...	..	17.8
Bacon[59] (procto-sigmoidectomy)	76 (five years or more)	5	52.6	23	34.3	12	17.9





FIG. 524. (*Left*) Dr. E. L. W., opaque enema seven months following abdominoperineal proctosigmoidectomy showing beginning dilatation of the bowel which will apparently assume the character of a normal ampulla.

FIG. 525. (*Right*) M. B., opaque study showing the appearance of the bowel eight months following proctosigmoidectomy.

vided the delivery of fecal material is adequate, the mechanism of defecation depends primarily upon the reaction of the rectum to distension, which results reflexly in relaxation of the sphincter. It has been shown that postural tone of the internal sphincter is dependent upon a local mechanism probably related to the innervation. Change in tonicity of this muscle reflects only the degree of activity of the rectum and possibly the distal colon. The reciprocal relationship between the rectum and the internal sphincter is the basis of a mechanism which can secure co-ordinated evacuation. The stimulus to allow its occurrence in distention of the rectum and sufficient relaxation of the sphincter to allow some passive evacuation of fluid under its own pressure does not occur unless active reciprocal contraction of the rectum provides the driving force of the reaction. Such is in accord with the views of Best and Taylor.[110] The investigations of Goltz and Ewald on dogs are very interesting and bear some influence on our problem. These workers, who were able to keep their animals alive for years after transection or destruction of the spinal cord below the seventh cervical segment, observed that while diarrhea was interposed, defecation gradually became normal: one or two evacuations were noted daily, and on each occasion the rectum was well emptied.

White and Smithwick[1045] found that, after sympathetic denervation of the normal rectum and colon, no alteration was visible in the basic tone of the bowel, its peristaltic activity or its sensory acuity. Perhaps the explanation is only hypothetical, but it does seem possible, in addition to the preserved internal sphincter, for the circular muscle coat of the mobilized sig-

following this procedure. One recalls the experiments of Elliott,[1101] who found that the external sphincter, even when separated from its nerve supply, is not prone to degenerate, as do other voluntary muscles. That the external sphincter exhibits fatigue is well recognized. About three years ago, using a rubber balloon attached to a water manometer. we attempted to correlate the degree of contraction of the sphincter muscle in normal adults. We wished thereafter to make a comparison of the findings with patients upon whom proctosigmoidectomy had been performed. The results were informative to only a small degree, because of muscle fatigue and the inferior method employed. Certainly the ingenious apparatus designed by Gaston, which defines and differentiates the external from the internal sphincter, is superior. Mention should be made that when the presacral drain and the mushroom catheter in the bowel are removed after 48 and 72 hours respectively, voluntary contractions can be observed objectively. Ordinarily contraction of the sphincter subjectively is not noted until after the redundant bowel is removed, which is usually on the eighth day.

It has been our experience that wide removal of the levators, especially laterally (levators clamped and divided from ischium), does not cause impairment of function. One of our former graduate students, T. F. Reuther,[1102] has demonstrated that the lower end of the intermuscular plexus of Auerbach does not terminate at the lower end of the internal sphincter muscle but continues outward toward the skin and gives off branches to the external sphincter muscle. As this investigator states, "the external sphincter has a double nerve supply; the first and principal supply is from the medullated nerves of the sacral and coccygeal nerve roots; the second is from the nonmedullated nerves of the Auerbach plexus of the vegetative nervous system." It is our opinion that with removal of the rectum the afferent fibers arising in the wall are severed.[1103]

It is generally understood that the internal sphincter, designed to aid in the expulsion of feces, also assists to occlude the anal aperture by tonic contraction. This muscle, representing an aggregate of inner circular muscle fibers of the rectum into a single component, measuring from two to five millimeters in thickness and from one to three centimeters in width, and innervated primarily by the sympathetic and parasympathetic nerves, maintains perfection in control, especially of flatus and liquid feces.

According to Howell, the force of the tonic contraction of the internal sphincter is from 30 to 60 per cent less than that of the external sphincter, or from 35 to 40 per cent, according to Math. Like the rest of the rectal musculature, the internal sphincter muscle receives both contractile (motor) and inhibitory impulses (Gaskell). Thus, this muscle is thrown into a state of contraction by stimulation of the pelvic nerve parasympathetic (craniosacral autonomics) motor and, by the same token, is inhibited by stimulation of the hypogastric, sympathetic (thoracolumbar autonomics). The voluntary inhibitory center is located in the brain, while the defecatory or reflex center is situated in the cord opposite the base of the first lumbar vertebra in a tip of the cord known as the conus medullaris. As has been shown, the internal sphincter muscle does not exhibit fatigue as does the external sphincter. It is our opinion that the somatic innervation to the external sphincter is but minimally impaired, although the visceral supply to the internal sphincter is interrupted. How does one explain the fact then that patients following this type of operation develop a "reflex urge" for stool, do not soil during wakeful or sleeping hours and do not wear protective pads? As determined by Brown and Robertson[164] voluntary control over defecation involves only the external sphincter, which is not tonic but contracts reflexly in the course of the flexion reflex and in synergy with the remainder of the abdominal parietes. Pro-

larly the ten-year rate of survival—evidence the fact that the results in a larger group of patients than is now available do not compare favorably with those achieved by other methods, then shall we acknowledge our error and completely delete the procedure from our surgical armamentarium. As Wangensteen has aptly stated, "we cannot resolve our differences by debate but rather by analyzing our experiences critically and recording them truthfully. Time is the final arbiter of all things—until she has given her answer, let us be tolerant of our honest differences of opinion."

In the pages immediately preceding, the author has attempted to evaluate one type of resection for the treatment of rectal cancer. It is now our purpose to describe other methods. May it be said that, contrary to common belief, we do not condemn the Miles procedure, for it is frequently performed in our department, but its use is confined to selected cases. Of all the methods performed for this dreaded disease, the operation of Miles is certainly the most popular.

Abdominoperineal Operation—One-Stage Procedure with Permanent Colostomy (Miles). DESCRIPTION.[718, 719, 721, 722] The purpose of this procedure is to remove the tissue to which the tumor may have extended by way of the three extramural lymphatic chains,[719] as described on page 647, together with the cancerous rectum. (Fig. 527.) The method consists of the intra-abdominal liberation of the rectum and pelvic colon, the establishment of a pelvic diaphragm, the formation of a colostomy and, finally, removal of the extraperitonealized bowel through the perineum.

TECHNIC. *Abdominal Phase.* Under fractional spinal anesthesia and with the patient in the exaggerated Trendelenburg position, a left paramedian incision is made from the crest of the pubis to a point one inch above the umbilicus. After the rectus sheath is incised, the rectus retracted laterally and the peritoneum opened, the abdomen is explored carefully for the presence of metastasis and the condition of the growth noted. Contrary to the technic usually employed, mobilization in our cases is effected before division of the blood vessels. In female subjects, the uterus is held taut by a stout catgut suture. In the left pelvic gutter the ovarian or external spermatic vessels are encountered but they seldom necessitate ligation. The lateral fold of peritoneum is

TABLE 77

	ABDOMINOPERINEAL PROCTOSIGMOIDECTOMY	ABDOMINOPERINEAL EXCISION (MILES)
Applicability	80.3% of all cancers in this site	100% of all cancers
Colostomy	None	Permanent
Operative mortality	4.9%	From 5% to 10%
Operative time (average)	Abdominal phase: 50 min. Perineal phase: 40 min. (1½ hours)	Abdominal phase: 85 min. Perineal phase: 15 min.
Morbidity (average)	Postoperative Hospital period—11 days	21 days, plus
Healing of perineal wound (average)	3 weeks	3 months
Return to work (average)	From 4 to 10 weeks	From 3 to 6 months
Sexual impotence	8.3%	95% (T. Jones)
Abdominal colostomy versus perineal anus	Normal diet, normal sphincter muscle contraction; patient develops reflex mechanism. No pad or dressings	Restricted diet; daily irrigation, pads, dressings or receptacles must be employed
Survival, five-year	52 6%	53 6% (Cattell) 52% (Jones)
Grade A	93.3%	88% (Gabriel) 90% (Lahey)

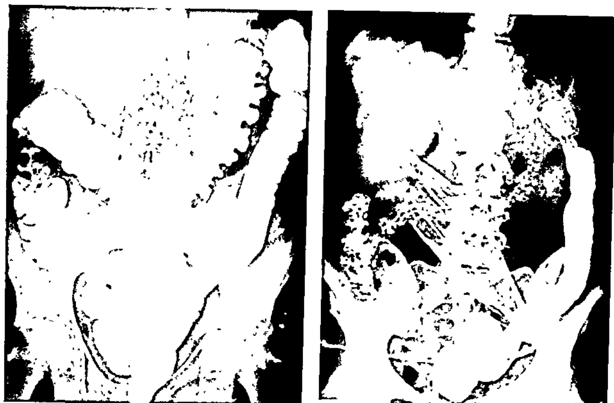


FIG. 526. (*Left*) C. T., appearance of the bowel nine months following proctosigmoidectomy. (*Right*) F. H., age 54, four and a half years after proctosigmoidectomy.

moid, which has been brought down to the anus, to assume postural tone in response to reflexes from the bowel above, even though the tone may be variable. It is our opinion that the visceral innervation is interrupted, but the presence of "local nerve plexuses," as reported by Jenkins, cannot be ignored. Certainly some degree of postural tone is manifest following proctosigmoidectomy. Apparently the accumulation of fecal material as the result of a normal diet provides distention of the new "ampullary sigmoid" resulting in an urge for stool. Thereupon the patient contracts voluntarily the anal sphincter muscles and voluntarily empties the bowel in a leisurely period of from 15 to 30 minutes. Continued observations must be made, and, in this respect, the dissections undertaken by McCrea and Weston on the innervation in this region may throw further light, especially on a hitherto unrecognized supply from some other source.

It has been interesting to observe the alterations in contour of the mobilized sigmoid in the pelvis following proctosigmoidectomy by roentgenographic study. Only a small number of our patients have been followed in this respect, yet over an inconstant period this sigmoid appears to assume the characteristic contour of a normal rectal ampulla, both by anteroposterior and lateral views.

In general this procedure may be compared as in Table 77.

Comment. In a series of 401 patients with cancer, the technic of abdominoperineal proctosigmoidectomy has been employed. The results of our experience have been recorded. At no time has this procedure been recommended for all cases of lower bowel malignancy, nor have we intended to imply that the ideal solution has been achieved. We have contributed little or possibly nothing of particular import but, like others, we are striving for a method "par excellence" yet to be designed.

If and when our statistics—and particu-

PLATE 16













All specimens removed by Miles method of excision. Attention is called to low-lying position of malignant growth. (Note: lower border of growth must be 6 centimeters or less from anal margin for Miles operation.)

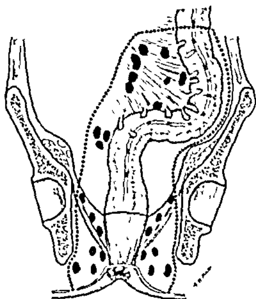


FIG. 527. Here is shown the final stage in the evolution of the radical abdominoperineal operation. Although it is possible adequately to remove the dangerous tissues of the downward and the lateral zones of spread by an operation carried out exclusively from the perineum, the greater part of the pelvic mesocolon has to be left behind because it is beyond reach. The pelvic mesocolon is very frequently the seat of metastatic deposits, so that it is important to remove it completely. The operative field depicted above is the only one by which the dangerous tissues of the three zones can be removed. (Miles: Cancer of the Rectum, London, Harrison.)

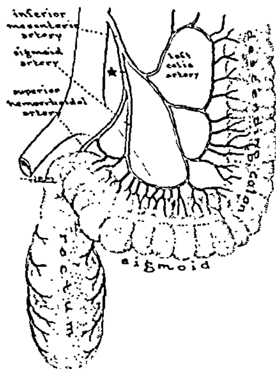


FIG. 528. Point of ligation of the inferior mesenteric artery.

incised, in the course of which the left ureter is identified and retracted. The incision is carried to the base of the bladder in the male or to the upper portion of the vagina in the female. By drawing the sigmoid to the left, the right leaf of the mesosigmoid is made taut. An incision is made in the parietal peritoneum well medial to the right ureter, which is readily visualized but not exposed. Division of the right leaf is continued and carried downward to meet the incision of the opposite side, behind the base of the bladder in the male or to the upper portion of the vagina in the female. The hand is gently introduced into the pelvis to separate the terminal portion of the pelvic sigmoid and rectum from the anterior surface of the sacrum to a point below the coccyx tip. Separation of the anterior structures is begun by elevating the divided edges of peritoneum with Babcock's visceral forceps. With the bowel drawn taut and pressed backward by a Murphy trowel, the line of cleavage is readily established by sharp and blunt scissor dissection. Thus, the rectum is separated from the upper portion of the posterior vaginal wall, in the female, or from the base of the bladder and seminal vesicles as far as the prostate, in the male. Mobilization anteriorly and posteriorly now being complete, the bowel is drawn taut to make prominent the lateral ligamentous attachments (lateral ligaments). These are divided on each side and, although they harbor the middle hemorrhoidal vessels, they seldom require a ligature. In this respect the Wangensteen pusher is of value in the application of ligatures deep in the pelvis. Attention is directed to the inferior mesenteric vessels which are doubly clamped, divided and ligated between the first and second sigmoidal branches (Fig. 528).

Ordinarily, heavy black, braided silk is used for the proximal ligature. Additional

division of the peritoneum from this site to the promontory of the sacrum may be necessary. The portion of bowel to serve as the permanent colostomy is selected and the peritoneum incised as far as its serosa. A small McBurney muscle-splitting incision is made in the left lower quadrant and a Payr clamp inserted to grasp the bowel at the point of selection (Fig. 530 A, B). Through the paramedian incision, an Ochsner clamp is applied to the bowel parallel to and immediately below the Payr clamp; the viscera are walled-off with packs and the bowel divided with cautery. The left peritoneal edge of the abdominal incision is held with flat Pennington hemostats to prevent displacement as the Payr clamp holding the proximal bowel end is withdrawn through the stab wound. Temporarily, the exteriorized proximal bowel is wrapped in a hot, wet towel. The distal end of the bowel is closed by suturing over the clamp (Fig. 530 C). Finally, a square strip of rubber dam is tied over the closed end with stout catgut (Fig. 530 D). Occasionally we employ the Zachary-Cope clamp because it consumes less time to manipulate. It has been our experience, however, that the clamp is large when pushed into the pelvis in its transverse axis and may become unfastened. The closed end of the bowel is guided and tucked into the sacral hollow. A pelvic diaphragm is now established by elevating the lateral attachments of the parietal peritoneum and running a suture to close the floor in its entirety. Where more peritoneum is necessary for closure, the lower portion of the bladder wall in the male may be separated. In the female, we occasionally find it advantageous to utilize the uterus. Finally, the abdominal wound is closed with figure-8 alloy steel wire sutures, 32 gauge, and a continuous stitch of alloy steel wire for skin, 35 gauge.

The exteriorized proximal loop of bowel which is to serve as the permanent colostomy is carefully inspected for viability and measured so that at least two and one-half inches will protrude through the wound. One or more alloy steel wire sutures are introduced on each side of the colostomy, if needed. A good index to determine how much space should be left is to insert one finger on each side of the bowel. Under no circumstance is a suture to be placed between the abdominal wall and the bowel. Dressings are applied around the exteriorized bowel and the Payr clamp removed. The mucosal edges of the bowel are separated in four quadrants and a mushroom catheter gently introduced for from 6 to 7 inches, after which a Daniel clamp (see p. 774) is applied around the bowel and fastened.



Fig. 529. Low-lying cancer of rectum. Miles type of excision indicated.

Perineal Phase. Our preference in this portion of the operation is the inverted or jackknife position, but because of untoward reactions, such as rapid fall in blood pressure and respiratory embarrassment, which occurred in five patients, it has since been discarded. Nor have we been interested in the Sims' or lateral position, largely, per-

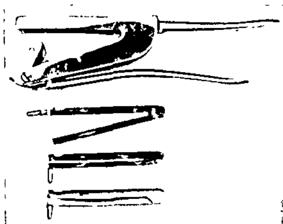


Fig. 531. Zachary-Cope clamp.

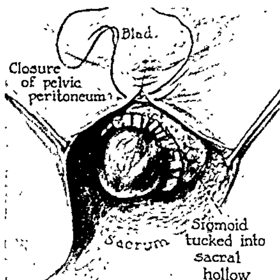


Fig. 532. Closed distal segment pushed into pelvis and establishment of pelvic floor begun.

around the closed anus and deepened into each ischiorectal fossa. Provided the dissection has been carried well down into the pelvis in all phases, there is little to be done from the perineal approach. Usually a single slit transversely will free the rectum from the tip of the coccyx. Anteriorly, the plane of cleavage between the rectum and the prostate in the male or between the rectum and the vagina in the female is established by sharp and blunt dissection until the site of the abdominal mobilization is encountered. From in front backward the levators on each side are hooked with the finger,

Table 78. Abdominoperineal Excision (Miles Technic)

Author	Year	Patients Operated Upon	Operative Mortality	Five-Year Survival Rate
Raiford[932]	1935	35	31.5 %	20 %
Jones, T.[513]	1935	127	11 %	52 %
Jones, T.[509]	1943	600	7.2 %	...
Jones, T.[510]	1947	535	3.7 %	52 %
David & Gilchrist[270]	1942	129	10 %	.....
Binkley[119]	1942	128	7 8 %	
de Oliveira[280]	1942	100	7.6 %	.
Rankin[838]	1942	136	6.6 %	..
Baker[72]	1944	49	2.0 %	. . .
Mayo, C. W.[683]	1943	276	6.15%	....
Hayden[456]	1945	131	10 6 %	...
Cattell[199]	1943	168	6.5 %	. ..
Daniel[263]	1945	90	11 %	....
Daniel[1090]	1948	100	4 %	....
Coller & Ransom[238]	1944	269	8 9 %	....
Woolf[1063]	1942	122	11.6 %	.....
Scarborough[904]	1939	95	9 09%	.....
Allen, *et al.*[12]	1947	38	2.6 %	.....
Hoxworth[487]	1947	167	14 %	33 %?
Mayo, C. W.[684]	1947	285	6.1 %	55.8%
Binkley & Deddish[132]	1947	350	2.3 %	....
Rankin[840]	1947	167	5.3 %	52.4%
Bacon (Group A)	1948	110	2.7 %	....

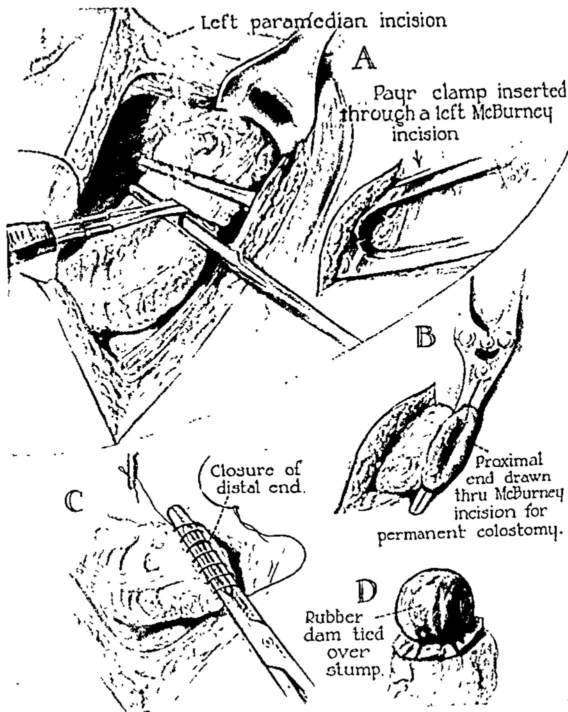


FIG. 530. (A) Bowel is divided between clamps preparatory to establishment of permanent colostomy. (B) Proximal loop held by Payr clamp. (C) Distal segment of bowel closed over clamp of Dennis type. (D) Rubber dam tied over distal stump prior to placement in pelvis.

haps, because of inexperience. To the writer, there have been many instances where it was found necessary as the dissection progressed anteriorly to remove the posterior vaginal wall and, in some cases, the prostate. Under these circumstances, to the author at least, the lateral position would have been extremely awkward. Routinely, therefore, the patient is placed in the exaggerated lithotomy position. The anus is closed by a purse-string of stout silk (Fig. 536 A) and a wide elliptical incision carried

clamped, divided and ligated. Mobilization now being complete, the closed, capped end of the bowel is withdrawn and the wound inspected for bleeding. A large square strip of rubber dam is tucked into the pelvic wound and gently but firmly packed from above downward with strips of plain gauze. Finally, dressings are applied and held in place by a T-binder.

IMMEDIATE POSTOPERATIVE CARE. Treatment following all types of resections is detailed under Preoperative and Postoperative Treatment (Chap. 28). The management of this abdominoperineal operation differs, however, in a few respects, which deserve description. The day following operation, the abdominal colostomy is irrigated through the mushroom catheter every four hours with two or three ounces of warm, normal saline solution. On the third or fourth postoperative day, both the catheter and Daniel's clamp are moved. For the perineal wound, removal of the gauze strips is begun on the second postoperative day

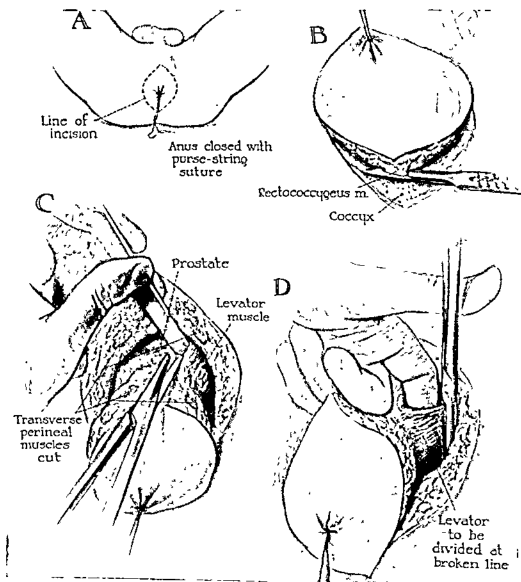


FIG. 536 A. Various steps in perineal phase. Note placement of clamp on levator.

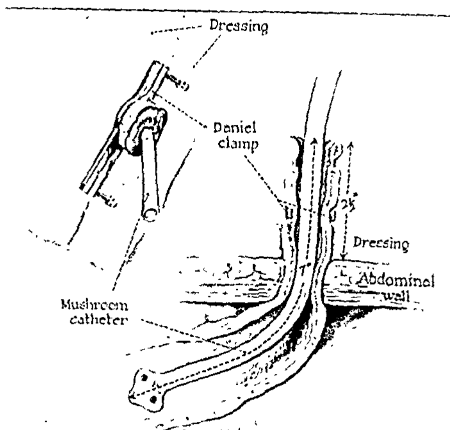


FIG. 533. Foley catheter introduced into bowel and held in place by Daniel clamp.

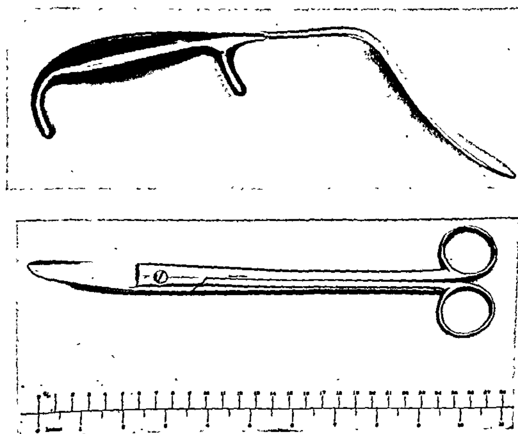


FIG. 534. (*Top*) Pancake retractor.
FIG. 535. (*Bottom*) Jones' scissors.

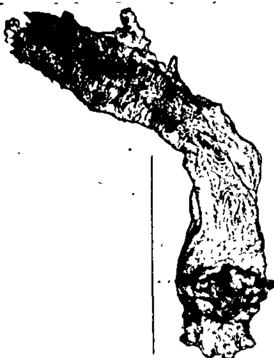
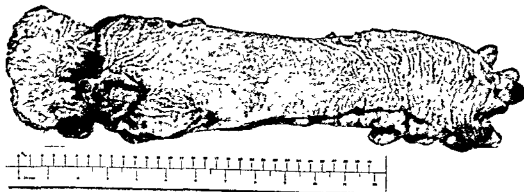




FIG. 537. Adenocarcinoma, Grade II, involving the lower portion of the rectum.

FIG. 538. (*Right*) Specimen removed by abdominoperineal excision showing a craterlike ulcer in the lower rectum.

FIG. 539. (*Bottom*) R. W., female, age 53: abdominoperineal excision (Miles).



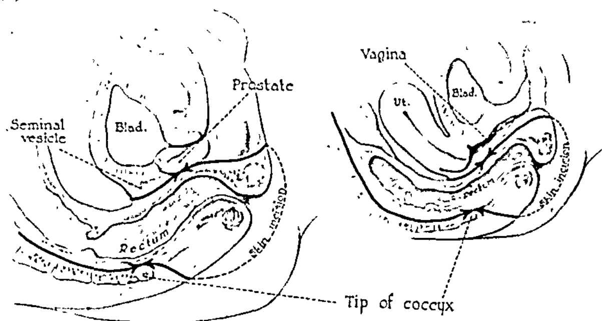


FIG. 536 B. Diagram showing mobilization achieved by abdominal and perineal dissection (*Lockhart-Mummery procedure*).

and completed by the third, together with that of the rubber dam. Patients are permitted out of bed and hot sitz baths are prescribed and given as soon as is practicable, usually the third postoperative day.

MORTALITY AND SURVIVAL RATES. In 1931, Miles selected a group of 84 cases in which the resectability rate was 35 *per cent. His* incidence of five-year survivals was 73 per cent, although the mortality in different series were tabulated at 32 per cent, 15 per cent and 7.6 per cent. Abel, in 1934, reported a series of 164 survivals in which 104 were alive and well five years following operation—a five-year rate of 69.3 per cent. It should be mentioned, however, that no note *is made of whether these cases* were selected, nonpalliative or palliative. Other groups are cited in Table 78.

Perineal Excision — One-Stage Procedure with Preliminary Colostomy (Lockhart-Mummery). DESCRIPTION.[623, 627] The procedure here outlined may be performed for cancer of the anus and rectum, but it is not indicated where the growth is situated at or above the rectosigmoid junction. Primarily, a colostomy is made. If the patient is a good risk, the perineal portion of the operation is done immediately, otherwise it is postponed for from seven to ten days, in which case the procedure becomes a two-stage operation. The perineal excision embodies the removal of the rectum and a few inches of the pelvic colon, the anus, the levator ani muscles together with the pelvic fascia reflected thereon, the greater part of the mesorectum, and the glands in the im*mediate vicinity. Lockhart-Mummery*[628] is of the opinion that there is very little difference between the amount of tissue removed by this operation and the abdominoperineal route. (Figs. 536 B and 556.)

TECHNIC. *Abdominal Phase.* The abdomen is opened through a midline or left paramedian incision for the purpose of exploration. While it has been our tendency *during the past few years to establish the* colostomy in the upper angle of the midline incision, the preference by far is to bring the colostomy through a muscle-splitting stab wound in the left lower quadrant of the McBurney or MacArthur type. Mobilization of the sigmoid is frequently necessary because the bowel drawn through the stab wound should be without tension. *The abdominal wound is closed in the* classical fashion, using figure-of-8 alloy steel wire sutures. In establishing a colostomy, the easiest method is to make a small slit in an avascular site of the mesosigmoid and

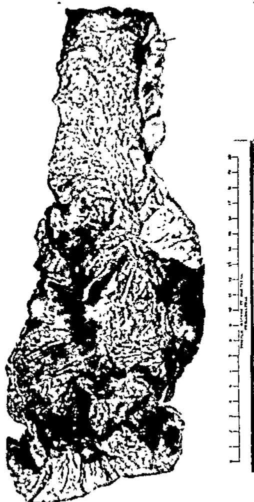


Fig. 543. Miles type of excision for cancer of low rectum. Anal canal must be included in the excision.



Fig. 544. (*Above*) Carcinoma of rectum.

Fig. 546. (*Right*) Polyposis with malignant degeneration. (Miles excision.)

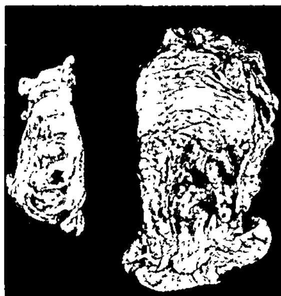


Fig. 545. Rectum and uterus removed by perineal approach. (Lockhart-Mummery excision.)

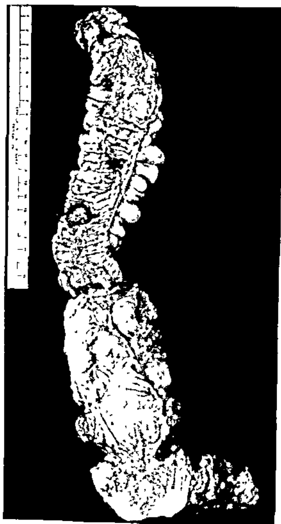




FIG. 540. Large carcinoma of low rectum. Distance is less than 6 cm. from margin. (Lockhart-Mummery excision.)



FIG. 542. Low-lying carcinoma of rectum removed by colostomy and perineal excision. (Lockhart-Mummery excision.)



FIG. 541. Low-lying cancer. Sphincter must be sacrificed. (Lockhart-Mummery excision.)

introduce a glass rod in order to hold the bowel on the abdomen. In such cases, the bowel is opened with the cautery or surgical diathermy at the end of 48 hours when the reparative processes are well established, the bowel becoming adherent to the abdominal wall. The disadvantage with a loop colostomy of this type, especially when permanent, is that the "spill-over" of feces into the lower blind loop of bowel is prone to incite an inflammatory process which may later result in a fistulous tract that is difficult to close. It is therefore a better practice to divide the mesosigmoid for a sufficient length to insure viability to each loop and separate these loops by suturing the peritoneum, fascia and skin layer by layer (Rankin technic) with alloy steel wire interruptedly placed. After dressings are applied, the bowel is divided between clamps. The lower clamp (Ochsner or Payr) is removed 48 hours later. Into the upper loop is placed a mushroom catheter, which is held in place by a Daniel's clamp.

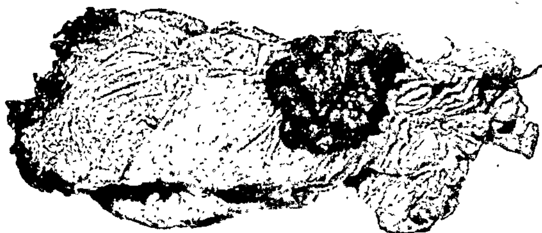


Fig. 549. Carcinoma of rectum.



Fig. 550. Malignant ulcer of low rectum.

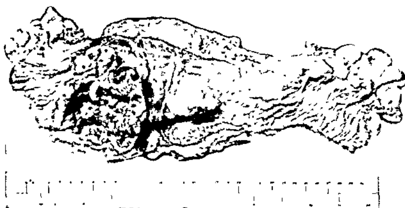


Fig. 551. Carcinoma of rectum involving anal epithelium.

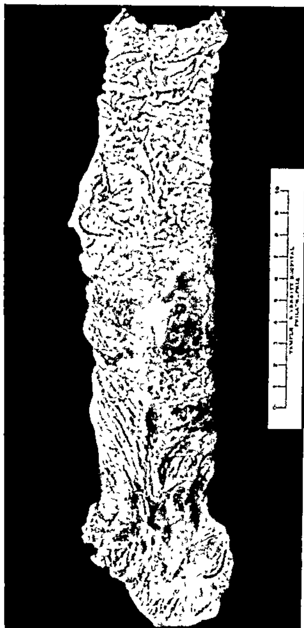


Fig. 547. Carcinoma of low rectum. (Excision by Miles technic.)



Fig. 548. Large excavatory ulcer of rectum. (Excision by Miles technic.)

Perineal Phase. The patient is placed in the exaggerated lithotomy position and the anus closed with a stout suture of braided silk. An elliptical incision is carried widely around the closed anus and deepened into each ischiorectal fossa. Mobilization is begun by dividing the structures posteriorly (musculature and pelvic fascia) and introducing the hand into the sacral hollow. Anteriorly, the rectum is separated by sharp and blunt dissection from the vagina in the female or from the posterior urethra, prostate and seminal vesicles in the male. By placing traction on the bowel, the levator on each side is clamped from before backward, divided and ligated as are the lateral ligamentous attachments. Where the cancerous growth involves the anal canal or lower rectum, one may elect to complete the operation at this point without opening the peritoneal cavity by dividing the mobilized bowel between clamps and closing the upper end over the clamp. The preferable procedure is to nip the peritoneum transversely with scissors and enlarge to accommodate a gauze pack or E-tape. Division of the peritoneum is continued backward close to the rectum. The mesorectum is divided as

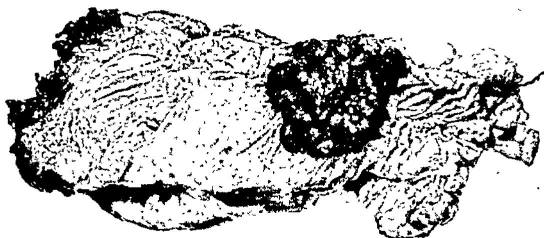


FIG. 549. Carcinoma of rectum.



FIG. 550. Malignant ulcer of low rectum.

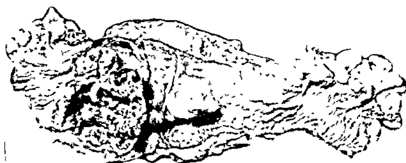


FIG. 551. Carcinoma of rectum involving anal epithelium.



Fig. 552. Carcinoma of mid and low rectum. Probably contact variety.

high as possible between clamps and ligated. Again the ligation of these vessels at a high point is facilitated by the use of the Wangensteen pusher. The mobilized bowel is drawn through the wound and wrapped in a towel. A site well above the growth is selected for the point of division and incised circularly through its peritoneal and muscular coats to form a wide groove. The pack or E-tape is removed and the cut edges of the peritoneum stitched to the mobilized bowel above the circular groove. Two right-angle clamps of the Mikulicz type are placed on the bowel in the established groove, which now lies below the closed peritoneal diaphragm. The bowel is divided between



Fig. 553. Carcinoma of rectum—circumferential.



Fig. 554. First stage of Lockhart-Mummery procedure. Segments of the sigmoid have been separated by the abdominal wall.



Fig. 555. Double-barrelled colostomy, the first step of an abdomino-perineal excision (Lockhart-Mummery method).

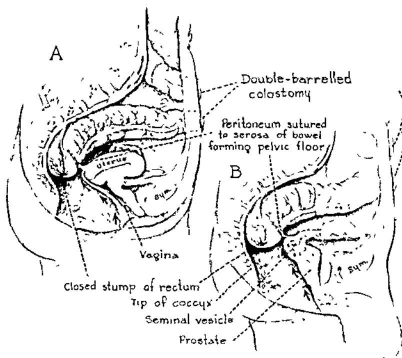


Fig. 556. Showing the double-barrelled colostomy: the distal blind loop and portion of the bowel removed by perineal excision (Lockhart-Mummery method).

clamps with the cautery and the freed segment removed from the operative field. The remaining stump is ligated with catgut, the clamp removed and the closed end of the gut inverted by means of a purse-string suture. Supportive sutures of wire are introduced through the stumps of the anterior levators and a large strip of rubber dam placed into the wound. Numerous gauze strips are gently but firmly inserted to fill the cavity thus formed; then dressings held in place by a T-binder are applied.

Immediate Postoperative Care. The preoperative and postoperative treatment has been detailed elsewhere (see p. 1017, Chap. 28), although the management of the colostomy and the perineal wound peculiar to this technic should be considered. The day following operation, irrigation of the proximal colostomy through the mushroom catheter is begun every four hours. Usually a few ounces of warm saline solution are used. On the third or fourth postoperative day the Daniel's clamp is removed. The clamp on the distal loop is permitted to remain in place for 48 hours, after which time it is removed. Irrigation of this blind loop should never be instituted. For the perineal wound, removal of the gauze strips are begun on the second and completed with the rubber dam by the fourth or fifth postoperative day. The patient is permitted out of bed on the second and hot sitz baths are ordered after removal of packing.

Comment. This procedure has a definite place in the armamentarium of low rectal and anal cancer. In poor risk patients and where a more formidable procedure is unwise, the colostomy may be established as the first stage and the perineal excision from 7 to 14 days later as the second stage. Where the growth involves the anal canal and lower rectum, the perineal excision may be performed extraperitoneally. Although this method carries with it a low rate of mortality, it is not especially popular in this country for three specific reasons: a double-barrelled colostomy is less desirable and is more difficult of management than a single stoma; the distal segment of bowel permitted to remain serves as a blind loop, mucus escapes and an intractable fistula may develop; finally, and most important, is that wide extirpation is not possible unless the peritoneum is opened.

While the radicability of this procedure is open to question, one must take cognizance of the recent investigations of Dukes[307] and the conclusions drawn therefrom, in which the five-year survival rate reported by Lockhart-Mummery is almost equal to that by the combined or abdominoperineal method. In fact, as described on page 727, the results following perineal excision are even better where the operative deaths are not included in the estimated rates of survival.

In our department, 26 patients from Group A were subjected to this procedure. There was one death, a mortality of 3.8 per

Table 79. Colostomy and Perineal Excision (Lockhart-Mummery)

Author	Year	No. Cases	Mortality Rate	Five-Year Survival Rate
Lockhart-Mummery[378]	1942	650	10.7%	52 %
Dukes[307]		391	...	44.9%
Rankin[840]	1947	56	16 %	.....
Rankin[839]	1937	162	7.4%	33.7%
Rankin[838]	1942	49	8 %	.....
Cattell[199]	1943	15	20 %	.....
David & Gilchrist[270]	1942	28	...	...
Baker[156]	1944	7	.....	.....
Rankin[840]	1947	56	10 %	.....
Daniel[263]	1945	46	11 %	.....
Bacon (Group A)	1948	26	3.8%	.....



Fig. 557. Specimen of cancerous bowel removed by colostomy and posterior excision.



Fig. 558. Similar procedure performed.

cent. The specific indications were usually low-grade obstruction and associated anorectal pathology, such as a primary pararectal abscess or one secondary to degeneration of the carcinoma into the ischiorectal fossa. In spite of the fact that these cases were selected, the rate of survival has been satisfactory, although none in Group A have reached the five-year period. There have been two instances of local recurrence.

The mortality rates from operation by this method and their survival rates are shown in Table 79.

Abdominoperineal Excision — Two-Stage Procedure with Permanent Colostomy, Lahey and Cattell.—Several years ago, Lahey and Cattell[200, 202, 582, 583, 586] devised a procedure incorporating the advantages of the one-stage Miles and the two-stage D. F. Jones technic of abdominoperineal excision. According to their recent reports,[199] this method has been largely discontinued by them in favor of the classical procedure of Miles. One cannot continue without awarding credit to these two surgeons, who, after initiating a new technic and employing it in a large group of patients, possess the fortitude to acknowledge and admit that a method devised by another is preferable and one rather to be chosen. Such candor portrays a sincerity of purpose which most certainly should serve as an example for those of us in the medical profession. However, it is the opinion of the author that this method has a definite, even though infrequent place, in the treatment of rectal cancer. Our experience during the past few years has been sparse. Nevertheless, there occurs an occasional case in which this method may be ideally chosen.

Examples have been cited where, at exploration, the bowel had been poorly prepared or possibly the gut immediately above the growth was impacted with feces and



Fig. 559. Carcinoma of low rectum. (Lahey-Cattell excision.)

yet was not obstructed. Also to be mentioned is perforation of the bowel at the site of the growth during the course of handling and dissection or the presence of a walled-off abscess. Should the condition of the patient suddenly become critical and it is deemed expedient to terminate the abdominal phase quickly, the operation may be concluded within a few minutes.



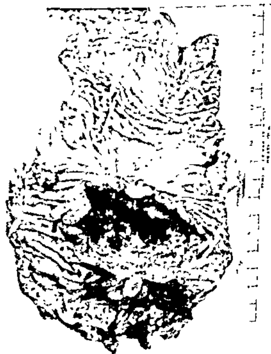


Fig. 560. (*Left*) Low-lying carcinoma of rectum. (Lahey-Cattell excision.)
Fig. 561. (*Right*) Deep excavating ulcer shown immediately above anal canal.

Description. This method permits cleansing of the tumor-bearing segment and opportunity for local edema and infection to subside. Inasmuch as the lower loop is left viable, the second stage may be postponed until the condition of the patient is satisfactory. The chief disadvantages are that the method embodies marked inequality of the two stages and entails opening the abdomen twice. Essentially this procedure consists of dividing the sigmoid, the upper end of which is drawn through the abdominal incision to serve as a permanent colostomy, while the lower end is brought through a stab wound. At the second stage, the abdomen is reopened in the midline, the implanted loop dissected free and the entire sigmoid pushed down into the pelvis. The patient is placed in the lithotomy position and the entire bowel delivered through a perineal incision.

Technic. *First Stage, Abdominal Phase.* Through a left rectus incision the abdomen is explored and the redundant sigmoid drawn medially. The parietal peritoneum is divided approximately 1 cm. below the edge of the bowel to a point directly over the iliac vessels. After selection of a point in the sigmoid for later division, the mesosigmoid is divided at right angles to the bowel down to but not including the superior hemorrhoidal vessels. (Fig. 563.) A small incision is made in the midline above the pubis and the peritoneum opened one inch above the bladder and elevated. A clamp is introduced through this incision and placed about the bowel immediately below the site selected for division. Through the primary incision a second clamp is applied above the first and the bowel divided with a cautery. The distal segment is drawn through the suprapubic incision and the skin closed loosely around it. Interrupted sutures are used to obliterate the area lateral to the proximal segment by approximating the parietal peritoneum in a direction vertical to the proximal bowel. The free edge of the omentum is anchored to the medial mesocolic peritoneum above the superior hemorrhoidal vessels; then the right side of the free edge of the omentum is sutured to the distal segment of the bowel and attached to the peritoneum beneath the stab wound, after which the left side of the free edge of the omentum is sutured to the mesentery of the proximal segment. This segment, which forms the permanent colostomy, is drawn through the center of the incision, which is closed. To prevent herniation of the small intestine, the peri-

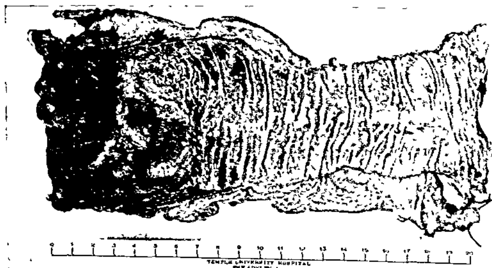


Fig. 562. Carcinoma of low rectum.

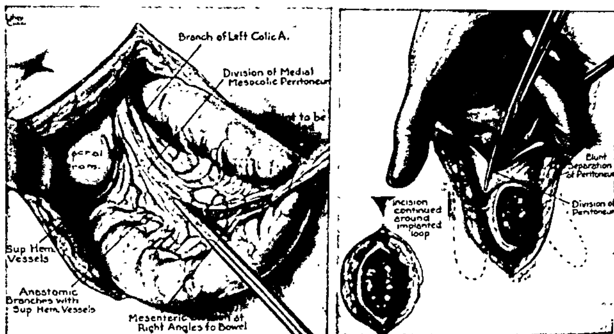


FIG. 563. (*Left*) First stage: division of the mesocolic peritoneum down to the superior hemorrhoidal vessels. (Lahey and Cattell: Am. J. Surg. 27:202.)

FIG. 564. (*Right*) Second stage: inset shows continuation of the midline incision around the closed implanted loop. After freeing the adhesions to the underside of the peritoneum, the implanted segment is freed. (Lahey and Cattell: Am. J. Surg. 27:202.)

toneum is anchored to the mesentery and to a fat tab on the amesenteric side. Both segments are held in place by clamps.

The clamp on the permanent colostomy is removed in 48 hours, although if a mild degree of obstruction is present it may be removed immediately. The clamp on the distal segment of the bowel is detached on the fifth day and irrigations are given thrice daily thereafter until the second stage.

Second Stage, Abdominal Phase. Approximately 15 days after the initial stage, the permanent colostomy is walled off with adhesive, the distal opening is closed and the abdomen opened through an incision from the umbilicus down to and around the implanted loop. (Fig. 564.) The bowel is freed of its attachments, a piece of rubber tissue is tied in place over the closed lumen, and the omentum is dissected down to the superior hemorrhoidal vessels, which are ligated. The pelvic peritoneum is incised on each side of the bowel as far as the bladder. (Fig. 565.) By continuing the dissection posteriorly, the rectum is further freed of its attachments down to the tip of the coccyx. The gut is pushed downward and folded backward on itself in the presacral space. The segment is covered with gauze to hold it in place and the pelvic floor closed, after the pelvic peritoneum has been freed. In male subjects the peritoneum is reflected on the bladder and may be used to assist in this closure, whereas in the female the uterus may be used to reinforce the suture line. The omentum, which has been detached from the implanted distal loop, may also be used if needed. The wound is then closed with a small drain placed down to the anterior peritoneum.

Second Stage, Perineal Phase. The patient is placed in the lithotomy position, the anus is closed and a triangular incision made around the anus. The presacral space is entered by a transverse incision through the pelvic fascia. The mobilized bowel is delivered through the wound and the levator ani muscles are divided on each side, during the course of which the middle and inferior hemorrhoidal vessels are ligated.

After the anus has been dissected free, a cigarette drain is loosely placed in the pelvic space and the wound partially closed.

In 1943, Lahey[1179] reported a series of 87 cases with an operative mortality of 13.8 per cent. In our group of seven cases there was one death, a mortality of 14.3 per cent.

Perineo-Abdominal Excision — One-Stage Procedure with Permanent Colostomy. Description. Applicable for growths involving the anal canal, rectum and recto-sigmoid, perineo-abdominal excision is especially ideal in short, stout subjects with narrow pelves. According to Gabriel,[373, 374, 377, 383] the procedure is easy to execute and less dangerous to the patient. Although a modification of the Grey-Turner two-stage method,[996, 997, 998] it necessitates opening the peritoneal cavity twice at the same operation and delivering the diseased bowel through the abdomen. It obviates, however, an open colostomy at the time the abdominal operation is performed, as suggested by Turner.

Technic. *First Abdominal Phase.* Through

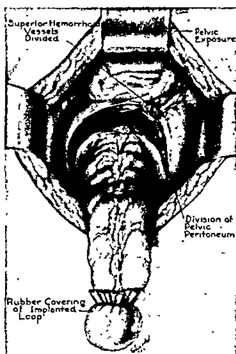


Fig. 565. Second stage: the superior hemorrhoidal vessels have been divided and peritoneal incision made laterally at the pelvic brim. (Lahey and Cattell: Am. J. Surg. 27:202.)

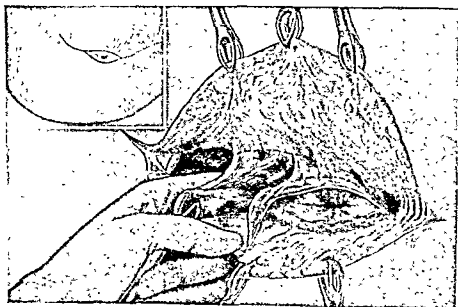


Fig. 566. Gabriel. Perineal excision of the rectum; patient in the left lateral position. The coccyx has been disarticulated and the left forefinger has been passed forwards above the levator ani on the right side; the dotted line indicates the line of muscle section. The inset shows the elliptical incision enclosing the anus, its posterior extremity being sloped to the right away from the middle line. (W. B. Gabriel: The Principles and Practices of Rectal Surgery, ed. 3, London, H. K. Lewis.)

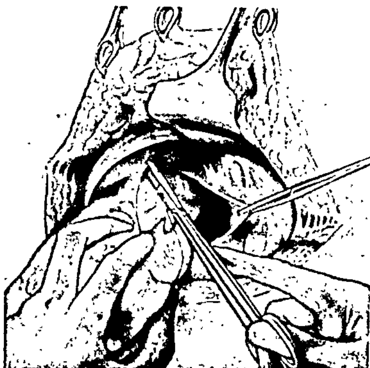
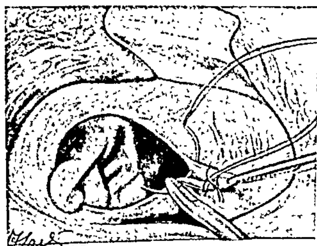


FIG. 567 A. The peritoneum is incised upwards with long scissors on each side of the recto-sigmoid. (W. B. Gabriel: The Principles and Practices of Rectal Surgery, ed. 3, London, Lewis.)

a right paramedian subumbilical incision the abdomen is explored and the operability of the growth confirmed. The abdominal wound is closed temporarily and the patient turned into the left lateral posture.

Perineal Phase. The anus is closed with two purse-string sutures and the lower rectum freed after disarticulation of the coccyx. The freed bowel is encased in wet flavine gauze over which is placed a sterile rubber glove. This is tied on tightly with two stout silk ligatures. Then the peritoneum is opened with scissors. Without encroachment on the superior hemorrhoidal vessels, the rectum is mobilized laterally and posteriorly and finally pushed up into the pelvis. The posterior third of the perineal wound is closed with drainage and the patient turned on his back as in the first step.

Second Abdominal Phase. After reopening the abdominal wound, the freed rectum encased in the glove is located and the lateral incisions are continued upward until the pelvic colon is deliverable through the abdominal wound. The inferior mesenteric



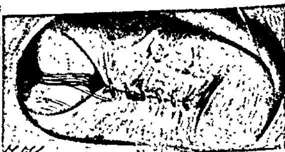


FIG. 567 B and C. After the mobilized rectum has been pushed up into the pelvis, the peritoneal suture is begun from below; it is then locked, wrapped round a gauze swab and is later carried on upwards from the abdominal aspect. (W. B Gabriel, Lon(Lewis, 1945.)

FIG. 567 D. The mobilized rectum and pelvic colon have been delivered through the abdominal incision; the dotted line shows the upward extension of the peritoneal incision required on the right side of the base of the pelvic mesocolon. The inset shows the abdominal incisions. W. B. Gabriel, ed. 3, London, H. K. Lewis.

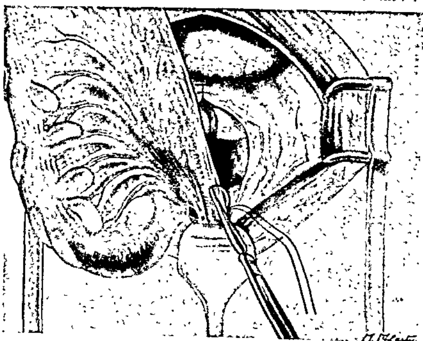


FIG. 568 A. Perineo - abdominal excision; ligation of the inferior mesenteric pedicle. W. B. Gabriel, ed. 3, London, H. K. Lewis.

artery is ligated with double silk between the first and second sigmoid branches and divided. Usually a second ligature is tied around the upper cut end of the vessels. The peritoneal space lateral to the iliac colon is closed, and through a left iliac muscle-splitting incision the entire rectum and pelvic colon are withdrawn. The peritoneal floor is restored and the primary abdominal wound is closed without drainage. Clamps are applied to the bowel protruding through the left iliac incision, and the gut is divided between clamps approximately 1½ inches in diameter external to the skin. The clamp on the proximal or remaining segment is removed and a rubber catheter introduced and sutured in place. The legs are held up and the anterior third of the perineal wound is sutured after a silk bag packed with gauze has been inserted.

A number of operative technics once popular have been discarded both on the

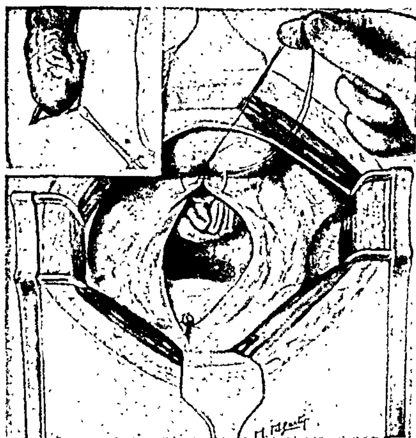


Fig. 568 B. The rectum and pelvic colon have been delivered through a separate left iliac incision (inset). The suture closing the pelvic floor, begun from below, is being carried upwards. (W. B. Gabriel, ed. 3, London, H. K. Lewis.)

Table 80. Results Following Perineo-Abdominal Excision (Gabriel)

Author	Year	No. Cases	No. Deaths	Operative Mortality	Five-Year Survival
Gabriel[377]	1944	400	62	15.5%	...
Dukes[307]		514		.	47.1
de Oliveira[280]	1942	100	22	22 %	..
Singleton[938]	1943	49	2	2 %	..
Turner[1109]	1947	33	7	15 %	...
Bacon (*Group A*)	1946	2	0	0	0

continent and in this country. Occasionally there may arise an instance in which a particular technic is suitable. For this reason and in order that this may serve as a book of reference, a few will be briefly described.

it are that (1) convalescence is moderately prolonged, (2) two operations are more formidable than one, (3) a double-barrelled colostomy is less desirable than a single stoma, and (4) the healing time of the pos-

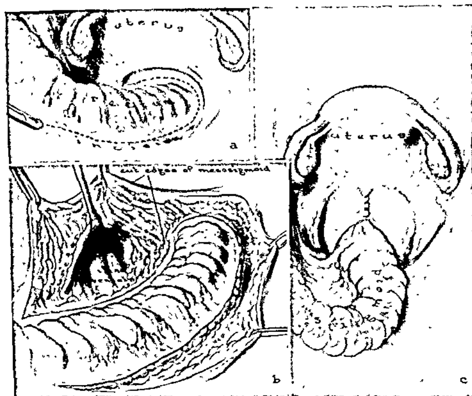


Fig. 569. D. F. Jones Operation. (a) The mesosigmoid is incised along the dotted line. (b) The mesosigmoid has been incised and the lateral leaves retracted. The iliac vessels and ureter are shown. (c) Following mobilization of the bowel, the peritoneum is sutured, forming a new pelvic diaphragm.

terior sinus is prolonged because of the leakage of mucus from the distal portion of the sigmoid. (Fig. 570.)

Abdominoperineal Excision — Two-Stage Procedure with Permanent Colostomy (D. F. Jones). Description.[505, 506, 508] This procedure was designed to permit, in patients unfit for the combined abdominoperineal operation in one stage, the same extensive operation with less concentrated shock and strain. Between stages, adequate blood supply is maintained by the vascular arch of the sigmoid, and irrigation of the distal segment facilitated. (Fig. 569.) The procedure recommends itself because the peritoneal cavity is entered but once, the perineal portion of the operation being entirely extraperitoneal. The objections to

Perineal Resection, with Preservation of Sphincters (Cunéo, Sénèque, Zagdoun). Description.[250, 591] This method, which is a modification of the original operation described by Cunéo,[255] entails resection of the rectum with preservation of the sphincter, sacrificing only the hemorrhoidal nerves on one side. According to these authors, this technic reduces the length of the operation, augments the operative field and is applicable to obese patients or those with narrow pelves.

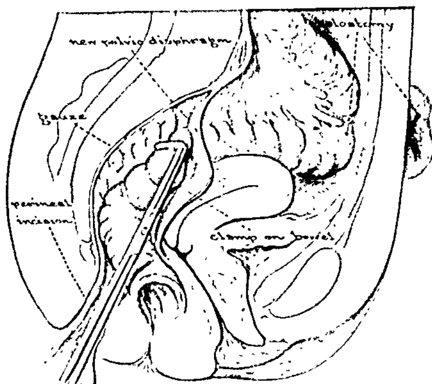


Fig. 570. D. F. Jones Operation. Sagittal section showing the colostomy. Below the new pelvic diaphragm is shown a right-angled clamp on the bowel to be removed.

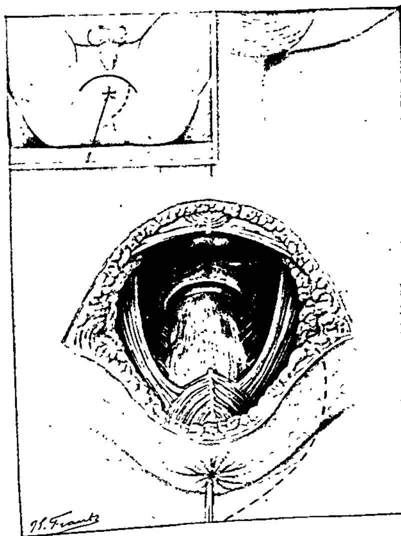


Fig. 571. The anterior aspect of the rectum is freed, the cul-de-sac of Douglas opened. The anterior portion of the levator ani can be seen. (Cunéo, Sénèque et Zagdoun; Sur un nouveau procédé d'extirpation du rectum par voie périnéale avec conservation du sphincter, J. de chir. 44:1.)

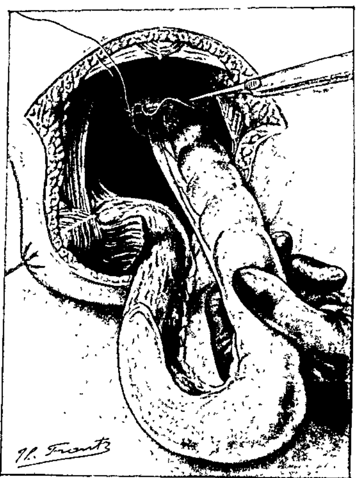


Fig. 572. The pelvic loop of the rectum is withdrawn entirely from the perineum. Suture of the peritoneal opening to the colon is made. (Cunéo, Sénèque et Zagdoun: Sur un nouveau procédé d'extirpation du rectum par voie périnéale avec conservation du sphincter, J. de chir. 44:1.)



Fig. 573. The rectum is completely freed. The segment to be resected is held between clamps. The dotted line shows the line of incision. (Cunéo, Sénèque et Zagdoun: Sur un nouveau procédé d'extirpation du rectum par voie périnéale avec conservation du sphincter, J. de chir. 44:1.)

Like all resections by the perineal route, this method is limited and does not permit determination of the degree of mobility of the growth or the extent of metastasis. Anastomosis of the proximal with the distal segment or invagination through the latter is unfortunately followed by complications. Preserving the hemorrhoidal nerves on one side is unique.

COMMENTS. Our experience with this technic has been limited to two cases, and, probably because of lack of familiarity, the results were not encouraging. In one, an intractable fistula occurred which later disclosed a local recurrence. The second developed recurrence which necessitated colostomy and local excision.

Abdominosacral Resection—One-Stage Procedure without Permanent Colostomy (Hochenegg-Bickham). DESCRIPTION.[113, 450, 451] As originally devised by Hochenegg, the growth is resected by the sacral route, the abdomen being unopened, and the proximal end of the bowel drawn through the anal segment and sutured. In this way the sphincter muscles are preserved and the continuity of the bowel is restored. Bickham combined the procedure by beginning the operation with an abdominal incision through which the sigmoid is

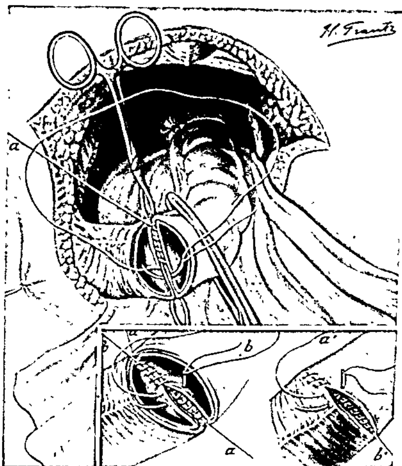


FIG. 574. Intestinal continuity is re-established by circular suture of a termino-terminal anastomosis in two planes. It could equally well be re-established by invagination along the anal canal. (Cunéo, Sénèque et Zagdoun: Sur un nouveau procédé d'extirpation du rectum par voie périnéal avec conservation du sphincter, J. de chir. 44:1.)

mobilized and dropped into the pelvis. The peritoneal floor is restored and the abdomen closed, after which the perineal portion is performed.

TECHNIC. *Abdominal Phase.* The abdomen is opened in the midline and the base of the bladder in the male or the pouch of Douglas in the female. The sigmoid colon is freed laterally as well as posteriorly, the operator keeping in mind that extensive mobilization is necessary for the bowel to be brought down in the second step. Finally,

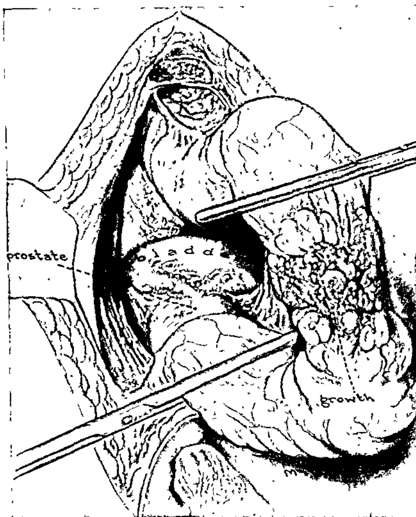


FIG. 575. Through a posterior approach the rectum is mobilized and Mikulicz's clamps are applied well above and below the growth.

contents are carefully explored for metastasis. When the superior hemorrhoidal artery has been identified, it is doubly ligated and divided above the first sigmoidal branch. The incision in the parietal peritoneum is carried down on both sides of the sigmoid close to the mesocolon and joined as they meet anteriorly behind the the sigmoid is pushed into the pelvis, the peritoneal floor restored and the abdominal incision closed.

Perineal Phase. The patient is placed in the lateral prone position and a straight or slightly curved incision made from the sacrum to a point 1½ cm. behind the anus. The incision is deepened and the anococ-

cygeus and the outer layer of pelvic fascia are divided. Following the removal of the coccyx and occasionally the fifth sacral vertebra by means of Rongeur forceps, the upper coursing fibers of the levator are severed and its attachments are divided as bowel is severed between them. The same procedure is accomplished above the growth. The mucosa of the distal or anal segment is denuded by placing four traction sutures to the cut edges, which, when carried through the anal canal, evert the mucosa

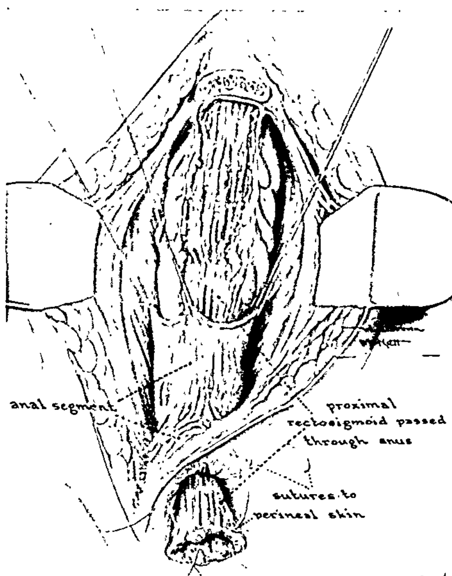


Fig. 576. The growth has been incised and the distal segment held with traction sutures while the proximal segment is drawn through the anus.

far from the rectum as possible. The inner layer of the pelvic fascia is now incised and the rectum freed on all sides down to the sphincter muscle. A point in the bowel well below the growth and above the sphincter muscle is selected for division. (Fig. 575.) Two clamps are applied at this site and the The traction sutures are then pushed through the anal canal so that the segment assumes its original position. In this way it is easily stripped. The distal end of the proximal gut is introduced through the anal segment until its cut edge protrudes beyond the anal margin. (Fig. 576.) Either

the clamp may be used to guide the bowel through, or traction sutures may be used. The upper edge of the freed anorectal segment which now surrounds the pelvic colon is sutured to it with chromic catgut, after which the denuded anal mucosa at its margin is sutured to the outer layer of the protruding pelvic colon. A rubber tube is introduced into the lumen of the bowel and tied in place. During restoration of the levators and the perianal wound, a clamp is placed on the rubber tube to prevent contamination.

Abdominosacral Resection — Three-Stage Procedure with Temporary Colostomy (Kirschner). Description.[548, 549, 550, 551] In order to avoid a permanent artificial anus and the disadvantages attending local excision or operation by the dorsal route alone, Kirschner advocated the following procedure in three stages.

Technic. *First Stage, Abdominal Phase.* The abdominal cavity is explored and a temporary, double-barrelled sigmoid anus established. (Fig. 577.) After an interval of a week the second stage is performed, which consists of a resection by the dorsal route. A slightly curved incision, with its convexity to the left, is made from the right side of the second sacral vertebra across the midline to the left, to end in the midline about 2 cm. in front of the anus. (Fig. 578 A.) The skin is retracted and the dissection continued upward until the coccyx and the fifth and fourth sacral segments are encountered. These are removed with the Luer rongeur. The middle sacral vessels are ligated and divided. The anococcygeal

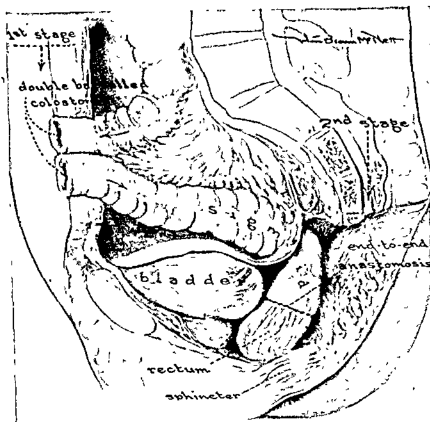


Fig. 577. Kirschner, 1st stage: formation of a double-barrelled colostomy. 2nd stage: showing the re-establishment of the continuity of the bowel by circular suture through a perineal incision.

ligament and the parietal layer of the pelvic fascia are incised transversely and the levators divided on each side as far from the rectum as possible. After incision of the visceral fascia, the rectum is freed on both sides and from the seminal vesicles, prostate the intestinal loop and contamination. By making traction on the rectum, the mesosigmoid containing the terminal branches of the superior hemorrhoidal artery is put on tension. This is divided between double ligatures. The sigmoid is drawn down and,

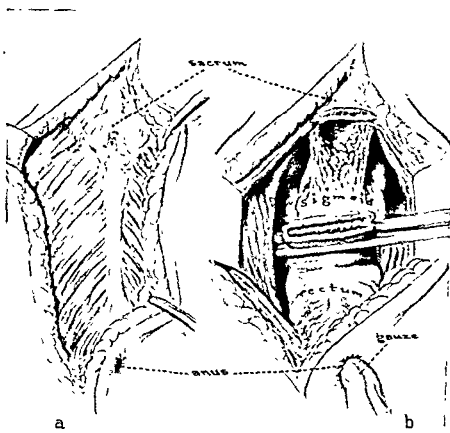


Fig. 578. Kirschner, 2nd stage. (a) Showing curvilinear incision *from a point above the sacrococcygeal articulation to the side of the* anus. (b) The cancerous bowel having been removed, the proximal and distal segments are held by clamps and partially joined by suture.

and bladder in the male, and the vagina in the female. Usually a rubber tube is passed around the rectum so that it can be retracted in any direction, facilitating further mobilization. The bowel having been separated from the anterior surface of the sacrum, the dissection is continued upward on both sides and anteriorly until the peritoneal fold of the pouch of Douglas appears above the posterior wall of the bladder or of the vagina. An incision is made in the peritoneum, close to the rectum, and enlarged. A gauze pad is introduced into the peritoneal opening to prevent protrusion of after the gauze has been removed from the abdominal cavity, the peritoneum is sutured to the bowel with interrupted catgut sutures. The diseased segment may be excised between two pairs of clamps, although Kirschner prefers to close the gut above and below the growth by means of the Petz suture instrument, the transsection being accomplished between the pairs of rows of clips. Continuity of the bowel is established by the telescope procedure (see Fig. 576) or by circular suture. (Figs. 577, 578 B.) If the latter is employed, the anus is dilated by an assistant, and end-traction

sutures are applied before beginning each suture line. Consecutively, a posterior Lembert, a posterior three-layer-Albert, an anterior three-layer-Albert, and an anterior Lembert suture are introduced. If the Petz suture instrument is employed, the edges

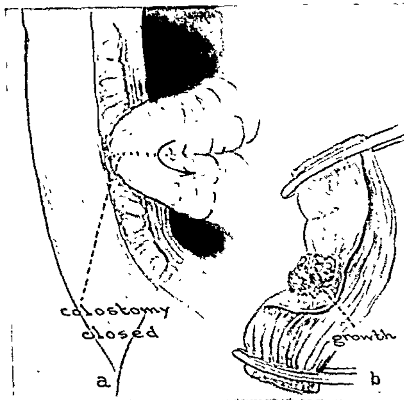


FIG. 579. Kirschner. (a) Third stage: closure of the colostomy, thereby re-establishing the continuity of the bowel. (b) the diseased bowel has been removed between clamps.

with the clips are removed in the course of the anastomosis; whereas, if clamps are used, these are removed following completion of the suture. The line of anastomosis is protected by suturing any tissue in the immediate vicinity over it; gauze packing is loosely inserted and the wound finally closed. The third stage is performed after the lower gut segment has entirely healed without a fistula and is freely patulous. At this time the abdominal artificial anus is closed according to the technic as described on page 810 (Mikulicz). (See also Fig. 579.)

Perineal Excision, with or without Preservation of the Sphincters (Yeomans). DESCRIPTION.[1070, 1071] This method, which is in reality a modification of the Quénu-Tuttle operation, may be employed in malignancy of the lower rectum and anal canal, provided the growth is confined to the terminal three inches. If the cancerous process involves the anal canal or an inch of the rectum immediately above it, the sphincter muscles must be sacrificed. Yeomans believes that this procedure is especially applicable in aged or debilitated patients whose general condition contraindicates more radical surgery, and in obese individuals who lack resistance to major operations.

TECHNIC. *Where Sphincter Muscles Are Preserved.* The anus is closed with a purse-string suture of heavy linen, the ends being left long for traction. A circular incision

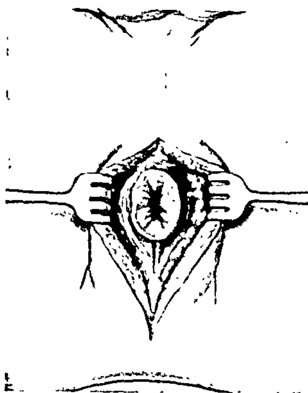


Fig. 580. Perineal proctectomy. The external sphincter ani is exposed and divided. (Yeomans: Proctology, New York, Appleton-Century.)

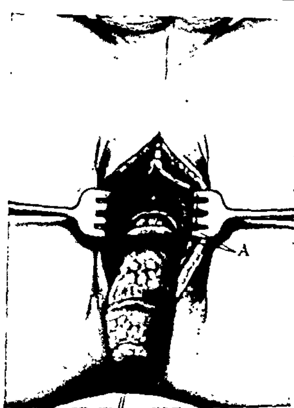


Fig. 581. Perineal proctectomy. (A) Peritoneal pouch opened by a transverse incision, exposing pelvic colon. (Yeomans: Proctology, New York, Appleton-Century.)

is made 1 cm. outside of the ligature, and the cuff of the anal canal dissected up between it and the external sphincter muscle. This muscle is divided posteriorly in the midline and the incision carried to the sacrococcygeal joint. (Fig. 580.) The incision is deepened in each ischiorectal fossa, exposing the levators. After the structures immediately adjacent to the coccyx have been severed, namely the ligaments, fascia and glutei muscles, the coccyx is removed. The retrorectal space is perforated by closed scissors which are then opened and withdrawn. This permits the insertion of the finger behind the levator, which, together with the fascia, is divided. Mobilization of the lower portion of the rectum is accomplished by careful dissection from the anterior structures, while the upper portion is freed by separating the mesorectum from the sacrum up to the peritoneal cul-de-sac and dividing the lateral ligaments. (Fig. 581.) In order to avoid bleeding from the middle hemorrhoidal vessels, this division is done between clamps. The mobilized bowel is now drawn down. In case the bowel is not of sufficient length to be drawn down this distance, the cul-de-sac is opened and the peritoneum cut close to the rectum on each side back to its mesentery. (Fig. 582.) The latter is then divided close to the sacrum to avoid injury of the superior hemorrhoidal artery. In this way, from six to eight inches of the bowel may be removed. After the bowel has been drawn down the desired length, the peritoneum is closed by suturing it to the pelvic colon. Behind the protruding bowel, three Stewart stitches of silkworm gut are inserted transversely. The gut is amputated one-quarter inch outside the anus and its layers are divided down to the mucosa, which is held by T-forceps and cut. After the mesosigmoid has been clamped, cut and tied, the

mucosa is sutured to the skin with stitches of chromic catgut. A rubber tube is inserted into the bowel for a distance of five inches. Finally, a rubber tube surrounded by gauze is introduced into the presacral space.

Where the sphincter muscles are sacrificed, as is necessary where the malignant process involves the anus or terminal portion of the rectum, a transverse incision is made across the perineum and carried on either side to the tip of the coccyx. The subsequent steps are as above mentioned, except that a shorter length of rectum is usually resected. Ordinarily it is not intended to open the peritoneal pouch. Finally, the bowel is amputated and the mucosa sutured to the skin.

Perineal Excision without Colostomy with Sacrifice of Sphincter Muscles (Lynch-Hamilton).[639, 641] DESCRIPTION. In an effort to eliminate an abdominal colostomy, Lynch,[635] in 1937, modified one of the many procedures designed by Cripps by removing the rectum with the sphincter muscles and dividing the upper rectum or lower sigmoid above the growth. No attempt is made to transplant or draw the cut-off edge of bowel at the peritoneal reflection to the anal margin or perineal skin. Instead a long fibrous tube is developed over a prolonged period to serve as a perineal colostomy. (See p. 728.)

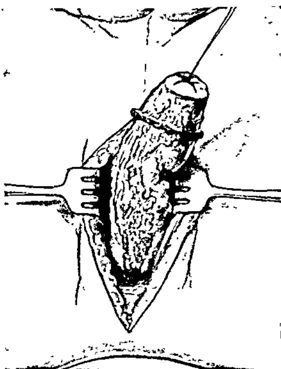
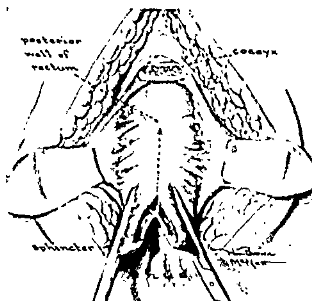


FIG. 582. Perineal proctectomy. The mobilized rectum is drawn down and elevated over the perineum by traction, exposing the posterior raw surface between the peritoneal folds of the mesorectum. (Yeomans: Proctology, New York, Appleton-Century.)

TECHNIC. The patient is placed in the customary exaggerated Trendelenburg position and the anus closed with a purse-string suture of silk. Incisions are made from the tuber ischii to the sacrococcygeal joint, after which the coccyx is excised. The rectum is mobilized, but the attachments of the levator ani to the sacrum are preserved. The incisions are continued anteriorly to meet in the perineum at the base of the scrotum or just behind the vagina. These incisions are deepened until the plane of cleavage between the rectum and prostate or rectum and vagina are defined. These structures are then separated by blunt dissection. The levators and lateral ligaments are divided between clamps and the peritoneum incised. In a few instances, the specimen to be removed is short enough so that the peritoneum need not be opened but merely stripped off the sigmoid. Upon opening the peritoneal cavity, the inferior mesenteric artery or its branches are ligated, preserving the blood supply to the point of severance of the sigmoid. Crushing clamps are applied to the bowel well above the tumor and divided there between with the cautery. Following removal of the clamp, a soft rubber tube is inserted into the bowel and secured by suture. The peritoneum is not closed unless there is prolapse of the small bowel. The wound is packed with gauze soaked with 10 per cent tannic acid in 50 per cent alcohol. This packing is kept moist with this solution and removed together with the rubber tube in 48 hours. Thereafter the wound is sprayed



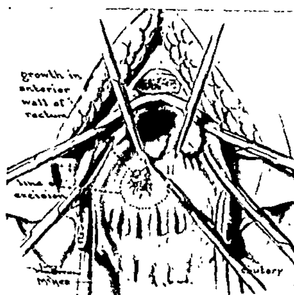


FIG. 583. (*Left*) Bevan's Operation. The sphincter muscle is incised posteriorly and the incision carried upward through the entire thickness of the rectal wall. The levator muscles have been divided and retracted.

FIG. 584. (*Right*) Bevan's Operation. The edges of the rectal wall are retracted and the growth excised as shown.

several times daily with the above solution.

This operative technic enjoys several proponents, among whom may be mentioned Hirschman,[477] Kleckner,[554] Tucker[994] and Wagner.[1010] *It should be truthfully* stated that the survival rate achieved by this procedure compares favorably with those reported by others. Lynch and Hamilton[610] recently cited their experiences in a series of 50 patients who had been resected more than five years previously. If one adheres to the method of calculation designed by Newman, then the 50 patients, less those dying of the operation (five), less those untraced (seven) and less those dying of unrelated causes (six), represents 32, which, divided into the number of five-year survivals (18), gives a five-year rate of cure of 53.1 per cent. The mortality rate is 10 per cent. Among the disadvantages to be mentioned are: exploration of the abdomen is not permitted; the long fibrous tube or canal extending from the peritoneal reflection to the perineal skin serves as a fibrotic tube devoid of mucous membrane and therefore subject to contraction; careful attention is required several times daily, over a prolonged period. It should be stated unequivocally that "perineal colostomy" as here established in no way compares with "perineal anus" as performed in the technic of "proctosigmoidectomy."

Local or Partial Excision. The field of applicability of this procedure is extremely small in that it should be reserved for benign tumors, such as simple adenomata or a rare case of cancer, where the growth is discovered early and is quite small, superficial and low-lying. It may be justified in an old and feeble patient for whom radical surgery is inadvisable. A method which may be employed in selected cases is that outlined by Bevan.[112] Here the patient is placed in a jackknife position and an incision made from the lower end of the coccyx to the anus. The skin and fascia are divided and retracted. Artery clamps are placed on the entire thickness of the sphincter and rectum, and the posterior surface of the rectum is split for a distance of from two to four inches (Fig. 583). The lesion is demonstrated and the neighboring tissues are palpated for glandular enlargements. Provided the growth has not penetrated the bowel wall, the lesion, through the entire thickness of the bowel, is excised widely

until the areolar tissue is exposed. The edges of the wound are sutured together with interrupted catgut (Fig. 585). Beginning at the upper end, the incision in the rectum is closed completely with interrupted sutures and another layer inserted with the knots tied inside the lumen of the bowel. A small wick of rubber-dam is insinuated into the lower angle of the wound and attached by suture to the anal skin. Finally, the posterior incision is closed with interrupted sutures. Our experience in Group A deals with 21 cases treated by this technic. The patients were carefully selected, because of age, active tuberculosis or coronary disease. Recurrence occurred in four instances, even though the growth was of small size and low-lying. In two, an intractable fistula resulted. In our opinion, it is a procedure to be recommended only in an occasional case.

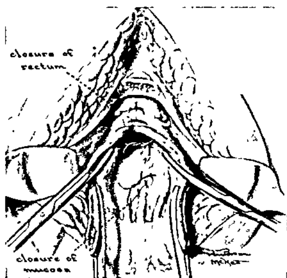


Fig. 585. Bevan's Operation. Following excision of the growth, the wound is sutured with catgut. The rectum is then closed.

Abdominal Resection — Sigmoidectomy. Methods of bowel exteriorization and re-establishment of continuity have been numerous since the report by Dupuytren. Contributions to the literature have been offered by Schede, Czerny, Heineke, Gussenbauer, Barton and Colley. Kohler (1881) is credited with having performed the first immediate restoration of continuity and Bryant (1882) with the first successful exteriorization procedure. Bloch[133] offered a lucid description of an exteriorized sigmoidal growth which he resected and later anastomosed. Paul[785] modified the procedure in 1895, but due to the popularity accorded Mikulicz,[712, 713, 714] both on the continent and in this country, the method is customarily referred to as that of Mikulicz. Aseptic anastomosis introduced by Halstead has been brought into prominence through the efforts of Parker, Kerr, Shoemaker, Stone, Cheever, Joll, Allen, Babcock, Wangensteen, Dunphy and Horsley.

The approach to removal of the sigmoid, rectosigmoid and rectal ampulla is discussed here under the heading "abdominal resection," and differs from resection (end-to-end anastomosis) by the perineal, vaginal or parasacral routes, a few of which have been described elsewhere in this chapter. (Goetze, Murphy-Tuttle, Berg, Pannett, Hochenegg, Bickham, Kirschner and Cunéo). For the purpose of clarity resection of these portions of bowel through the abdomen will be considered as follows:

A. Sigmoidectomy — Delayed Closure (Mikulicz, Rankin Modification).

B. Sigmoidectomy — Immediate Closure —Open or Closed (Aseptic).

C. Rectosigmoidectomy—Immediate Closure—Open or Closed (Dixon, Wangensteen).

D. Rectosigmoidectomy — With Permanent Colostomy (Hartmann).

A. Delayed Closure (Mikulicz). *Description.* Applicable for carcinoma of the mobile portion of the sigmoid, this method of exteriorization has been especially popular because of its simplicity and safety. It may be well chosen in unfavorable and elderly patients who are unable to undergo more radical surgery, or where the bowel is moderately distended. As to its disadvantages, one must mention the high rate of recurrence reported by many who feel that sufficient bowel and mesosigmoid cannot be

removed. To a large degree, this is true, since so much bowel is needed for exteriorization. The prolonged convalescence attending the numerous stage procedures is an additional disadvantage. The method is contraindicated in the presence of a short mesosigmoid, in those patients with a thick abdominal wall, where the growth is located low in the sigmoid and, of course, in the presence of acute obstruction.

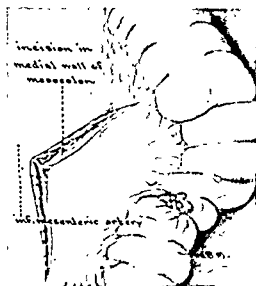


FIG. 586. Triangular incision with the apex downward in the medial leaf of the mesocolon.

Technic: First Stage. The abdomen is opened preferably through a left oblique or diagonal incision, and with the small intestine packed away, the sigmoid is held medially. Mobilization is begun by incising the peritoneum in the left lateral gutter, during the course of which the left ureter is identified and retracted. The sigmoid is drawn laterally and a V-shaped incision made in the mesosigmoid so that its apex is at its root. (Fig. 586.) The section of mesosigmoid to be removed must be sufficiently wide to contain the gland-bearing areas and so constructed that the blood supply remains unimpaired to the two limbs of the bowel to be permanently retained. The cancerous sigmoid, having been well mobilized, is held taut while the proximal and distal limbs are united with interrupted catgut sutures. This step—formation of the spur—is extremely important and deserves more than passing comment. The spur is established by placing the limbs parallel to each other; by rotating the limbs toward the midline in order to avoid impairment of blood supply, the longitudinal bands are approximated with interrupted catgut sutures for a distance of three inches or more.

The peritoneum is closed around the protruding bowel. By suturing the fascia and skin in layers, using alloy steel wire, the abdominal wall is snugly closed about the protruding loops of the bowel (Fig. 587). In the presence of much distention, the bowel proximal to the growth may be nipped, a rubber catheter inserted and held in place by a purse-string suture.

Second Stage. Forty-eight hours later, although some authors prefer a period of seven days, the excess bowel, cancerous growth and mobilized sigmoid are removed by cautery approximately five centimeters above the skin level (Figs. 588, 592, *left*). Thus two colonic segments remain.

While the foregoing represents the classical first and second stage of the Mikulicz method of resection, it is seldom adhered to in this detail. Ordinarily, the second-stage maneuver is performed with the first. After dressings are applied, two pairs of Ochsner or other suitable clamps are applied to each bowel loop and divided between by cautery. Then, after discarding, the cancerous bowel the clamp on the proximal loop may be removed immediately, although a 48-hour period is preferable.

Third Stage. Crushing the spur. Ordinarily, a period of from 10 days to a few weeks is permitted before the septum or spur between the proximal and distal segments is obliterated (Fig. 592, *right*). The gloved index finger of each hand is introduced into the two bowel loops to determine the lower extent of the spur. Then using the finger as a guide, one blade of the crushing clamp or enterotome is passed into each bowel lumen. The clamp is closed to the first notch and tightened daily thereafter until necrosis

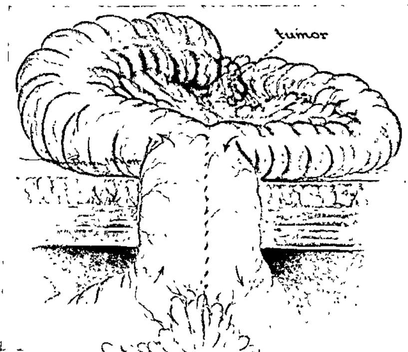


Fig. 587. The growth has been drawn through the abdominal wound and the serosa of the ascending and descending limb stitched on their lateral and medial sides. Closure of the peritoneum, aponeuroses and skin is complete for the first stage.



Fig. 588. Second stage. The bowel containing the growth is removed approximately one inch above the skin surface.

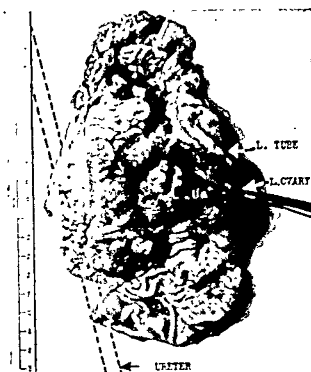


FIG. 589. M. M., female, age 35: Mikulicz resection.



FIG. 590. W. H.: Mikulicz resection.

occurs in the intervening walls, when the clamp sloughs through and falls off. This occurs usually from five to seven days later. In some instances, we have carefully divided the spur by a "cut and suture" method using fine No. 36 alloy steel wire interruptedly. In such an instance, it is important to locate the mucosa precisely.

There is and always has been some controversy as to the best time to obliterate the spur and close the aperture. It is the custom in our department to follow no specific rule but rather individualize each patient. In the main, we prefer to apply the clamp approximately one week before the patient is discharged from the hospital. Our criteria are that there must be no edema of the protruding mucosa, the wound must be clean and free of infection, and the surrounding skin must be healthy.



FIG. 591. M. W., female. Resected specimen showing tubular narrowing of lumen resulting from prolonged roentgen therapy. Residual carcinoma found.

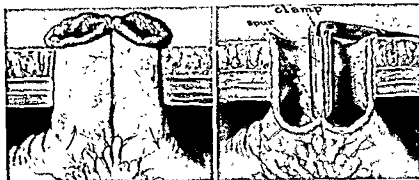


Fig. 592. (*Left*) Appearance of the ascending and descending limbs following excision of the bowel distal to the skin surface. (*Right*) Third stage. Cross section of the upper and lower limbs showing Mikulicz clamp in position.

Fourth Stage. This step may be accomplished by an extraperitoneal or intraperitoneal technic. Both portions of bowel have of course been carefully prepared by sulfathalidine for several days as described under preoperative and postoperative treatment (see p. 1011, Chap. 28). (For Results of Mikulicz, see Table 81A, p. 811.)

Extraperitoneal Method of Closure. This is simple and more safe than the other methods, since the peritoneal cavity is unopened. Its disadvantage lies in the fact that closure may be established under tension, in which event failure is encountered, necessitating repetition.

Technic: The edges of the colonic openings are dissected free and freshened (Fig. 594). The bowel is then closed transversely by a continuous row of fine chromic catgut sutures, overlaid by a second row interruptedly placed. The bowel is now tucked into the wound and the fascia, subcutaneous tissue and skin approximated in individual layers with alloy steel wire interruptedly placed. (See Colostomy, Chap. 20, p. 867.)

Intraperitoneal Method of Closure. Undoubtedly this is the procedure of choice, although it permits the possibility of peritoneal contamination.

Technic: The bowel is cared for as previously outlined and the skin edges rendered as sterile as possible. Mobilization is begun by an elliptical incision around the bowel and carried through the underlying structures until the peritoneal cavity is opened. In this respect we do not hesitate to use the finger method as a guide, as described by Rankin and Graham[833] (see p. 867, Fig. 633). The edges of the bowel mucosa are freshened and sutured together transversely by a continuous stitch of fine chromic catgut. A second seromuscular row of catgut or fine alloy steel wire interruptedly placed is inserted. The closed bowel is dropped into the peritoneal cavity, sulfathiazole is sprinkled over it and it is then covered by omentum. Finally, the abdomen is closed in layers using alloy steel wire sutures. A wick of rubber-dam or perforated rubber tubing is inserted at each end of the wound suprafascially.

In some instances, we have employed the

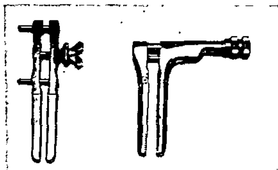


Fig. 593. Crushing clamps. (*Left*) Stitt. (*Right*) Garlock.

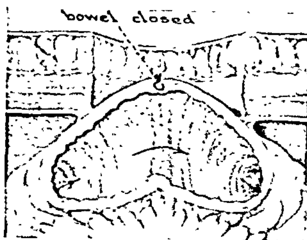


FIG. 594. Fourth stage. Method of extraperitoneal closure.

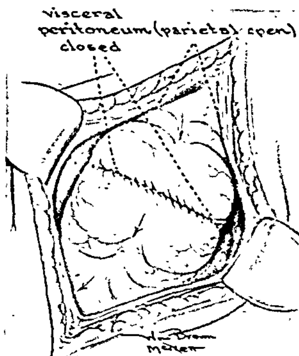


FIG. 595. Intraperitoneal method of closure.

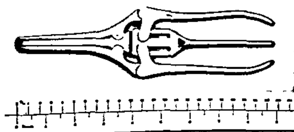


FIG. 596. Rankin intestinal clamp.

delayed method of closure advocated by Pemberton and Coller.

RANKIN MODIFICATION OF MIKULICZ *OPERATION — OBSTRUCTIVE RESECTION.* As modified by Rankin,[856] this procedure possesses several distinct advantages which may be enumerated as follows: (1) greater removal of bowel and mesosigmoid is permitted; (2) the flexibility of the procedure is not necessarily confined to only mobile segments, such as sigmoid and transverse colon; (3) performance as either a one-stage or two-stage maneuver with closure by either open or aseptic technic is permitted.

Obstructive Resection, Two-Stage Method. Technic: The abdomen is opened, preferably through a left oblique or Babcock incision, and mobilization begun precisely as outlined on page 805 (Mikulicz resection). The sigmoid is drawn to the side and a wide expanse of mesosigmoid is divided between clamps. The section of mesosigmoid must include the node-bearing areas as far as the root of the mesosigmoid, and division must be so constructed that the blood supply to the proximal and distal segments of bowel remains unimpaired. The Rankin three-bladed clamp is applied, above which are placed two Ochsner or some other type of suitable hemostats. Division of the bowel is made by cautery, and the cancerous bowel with the Ochsner clamps and attached mesosigmoid is removed from the operative field. The rent in the mesosigmoid is obliterated by suture, using fine chromic catgut, care being taken to avoid inclusion of the blood vessels. All raw areas are peritonealized. It has been our custom to sprinkle two and one-half grains of sulfathiazole crystals over the viscera, cover with great omentum and introduce a Babcock sump drain to the depth of the pelvis. The abdominal wound is closed in layers around the two limbs of the bowel, using alloy steel wire interruptedly placed. Ordinarily, the sump drain is held in the lower edge of the incision and removed after 48 hours. The Rankin clamp is *permitted* to

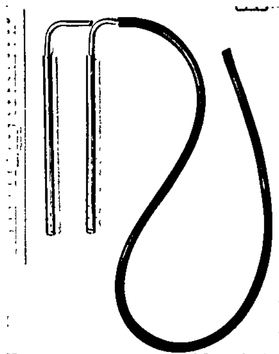


FIG. 597. Babcock sump drains.



FIG. 598. Napkin ring deformity involving proximal sigmoid (iliac portion). Sigmoidectomy performed.

remain in place for 48 hours, at which time the proximal blade is opened, the distal blade being left to slough off. When the edema has subsided, the spur is crushed in the usual fashion.

Second Stage: This step consists of closure in a manner similar to the technic described on page 809 (see Mikulicz). Rankin found that where the spur was cut properly, spontaneous closure occurred in more than 50 per cent of his cases, while Jones[516] noted an incidence of 14 per cent.

In Table 81B the experiences of various authors with this superior type of resection are shown.

B. SIGMOIDECTOMY — IMMEDIATE CLOSURE. This discussion embodies a description of the technic by the open and closed methods. It is not the purpose of the author to invade the field embodying this controversial subject, inasmuch as both methods present certain advantages as well as disadvantages. Each has its proponents, based largely on the results obtained by the indi-

TABLE 81A. MORTALITY RATE AND SURVIVAL RATE (MIKULICZ)

Author	Year Reported	No. Patients	Mortality Rate	Survival Rate 3 Years	Survival Rate 5 Years
White and Amendola[1046]	1944	18	22.2%	..	....
Patterson and Webb[784]	1940	63	27 %	54%	....
Whipple[1043]	1943	28	28.5%	. .	....
Rankin[838]	1942	38	10 5%	. ..	....
Hayden[456]	1945	10	20 %	...	....
Miller[725]	1923	70	35 %	....	....
Nordmann[762]	1926	144	28 %	. ..	....
Gibbon & Hodge[397]	1941	14	36 %	....	....
Rosser[885]	1942	31	9 %	....	....
Allen[11]	1939	33	21 %	....	....
Wilkie[1037]	1939	42	21 %	....	....
MacFee[645]	1937	68	28 %	....	....
				....	....

TABLE 81B. MORTALITY RATE AND SURVIVAL RATE (RANKIN MODIFICATION)

Author	Year Reported	No. Patients	Mortality Rate	Survival Rate 3 Years	Survival Rate 5 Years
Rankin[638]	1942	59	10.1%	....	...
Lahey[581]	1939		....	....	47%
Cattell[109]	1943	133	11.3%	..	....
Jones and Brubaker[516]	1943	78	6.5%	..	....
Jones[511]	1947	117	5.1%	.	..
Cole[234]	1944	...	3.2%	....	....
Coller and Vaughan[237]	1945	6	0	....	....
Pierpont, Peterson & Dulin[605]	1945	33	15.1%	..	...
Pfeiffer[601]	1945	34	17.6%	...	..
Romano & Trachtenberg[676]	1943	29 1-stage	52 %	..	..
		14 2-stage	43 %	...	....
Berger[101]	1944	30	10 %	....	....
Murdock[743]	1943	19	5.3%	...	....
Mayo, C. W[651]	1942	184	5.4%	...	...
Bacon (Group A)	1948	38	7.8%	..	.

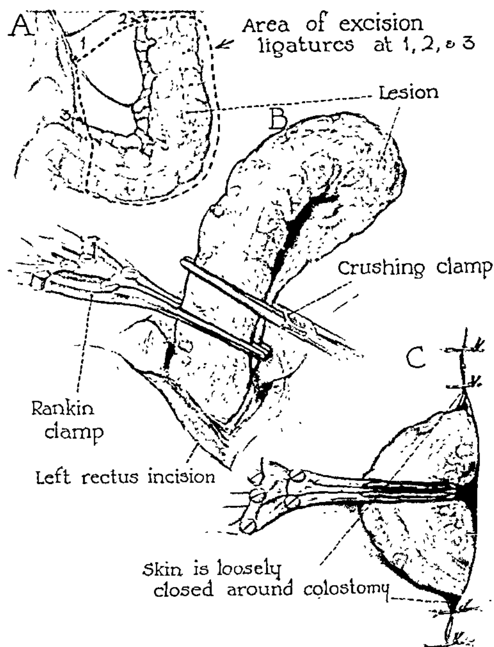


FIG. 599. Rankin obstructive resection.

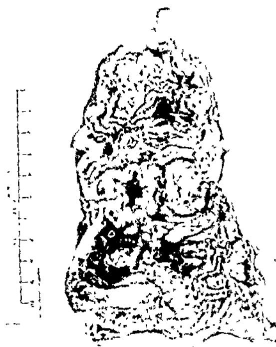


FIG. 600. D. M., male: Rankin obstructive resection.

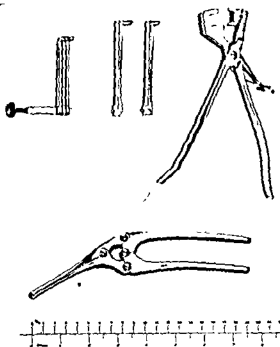


FIG. 601. (*Top*) Wolfson intestinal clamp.

FIG. 602. (*Center*) Payr clamp.

FIG. 603. (*Bottom*) (*Left*) Furniss clamp. (*Right*) Clute modification of Furniss clamp.

vidual surgeon and the particular method which is found most suitable in his hands.

The selection of a particular type of clamp is one of preference, although, in part, the location of the growth, the obesity of the patient, and the pelvis, *per se*, may alter one's decision. For example, a growth low in the sigmoid, at the rectosigmoid junction or in the upper ampulla of the rectum is certainly not well adapted to an anastomosis using a Furniss, Clute-Furniss or Rankin clamp. For such, the Wangensteen clamp, especially, and the Wolfson may be employed to satisfaction. It is here that open anastomosis may be ideally chosen. In the sigmoid proper, any type, including the Parker-Kerr and Stone clamps, may be utilized.

Closed Method. The abdomen is opened in the customary fashion or, as is our preference, through a low left oblique (Babcock) incision. Resectability of the growth is determined and the viscera walled off with hot packs. The sigmoid is drawn to the side and a wide expanse of mesosigmoid is divided between clamps. The section of mesosigmoid must include the node-bearing areas as far as the root of the mesosigmoid and the division must be so constructed

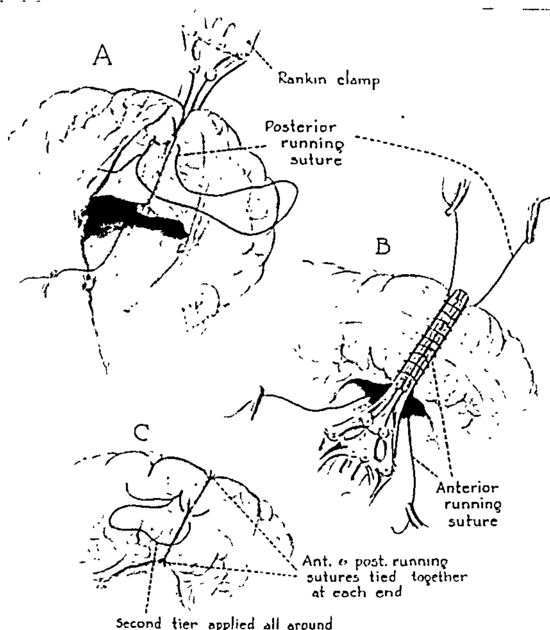


Fig. 604. Closed method (Rankin).

that the blood supply to both segments of bowel remains unimpaired. At this point, the clamp selected is applied with the handle toward the midline. Our preference has been the Furniss-Clute modification and the one designed by Wangensteen. The bowel is divided between clamps by means of the cautery. Remaining are the two segments of bowel caught in the jaws of the clamp. By rotating the clamp laterally, the posterior aspect of each limb is presented. A continuous suture of fine catgut is inserted and the ends left long and held taut. By rotating the clamp medially to its original position, the anterior limbs are presented. A continuous suture of fine catgut is now inserted over the clamp, and, as the ends are held taut, the clamp is gently withdrawn, thereby inverting the ends of the bowel. The respective ends are tied at each extreme, and a row of fine silk is placed interruptedly on both the anterior and posterior surfaces. After the patency of the anastomosis is determined, tabs of fat are

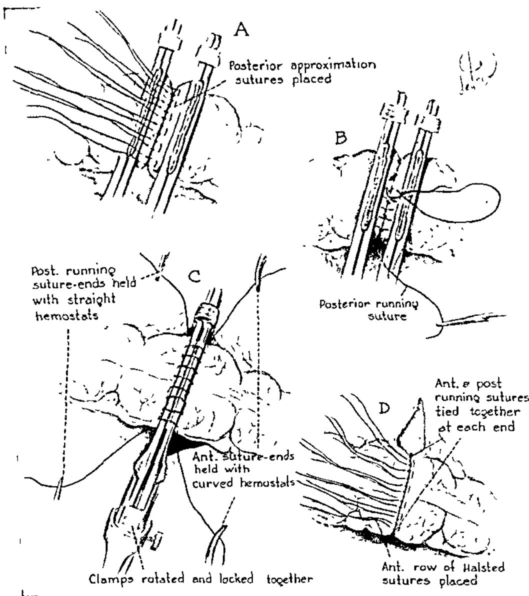


FIG. 605. Closed method (Wangensteen).

stitched over the line of suture. The rent in the mesosigmoid is closed and all raw areas are peritonealized, sulfathiazole crystals are sprinkled over the anastomosis, a Babcock sump drain is placed in the pelvis for from 48 to 72 hours, and the abdomen is closed in layers. As was our custom in all types of immediate closure, a proximal transversostomy, cecostomy or preferably appendicostomy was established. More recently, however, no proximal vent has been made.

Comment. The use of nonabsorbable sulfonamides in more than 800 resections has proved of utmost value and confirms the investigation of many, including Poth,[816] Dixon[297] and Behrend.[93, 95] More recently, we have employed sulfasuxidine with penicillin and streptomycin. As a matter of fact, the author is of the opinion that, with these adjuncts, little difference is offered whether the anastomosis is performed by the open or closed technic. Another point to be considered is the use of catgut, compared to

PLATE 17



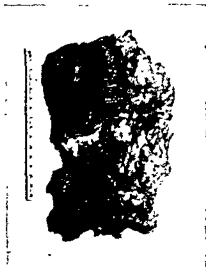
E. L., male, age 67. Rankin obstructive resection.



H. L., age 31. End-to-end anastomosis performed over Furniss clamp, and complemental appendicostomy.



B. C., age 53. Sigmoidectomy performed by Wangensteen technic.



B. G., age 65. Resection with end-to-end anastomosis using Furniss-Clute clamp.



Sigmoidectomy—open anastomosis; complemental cecostomy.



J. S., male. Sigmoidectomy—immediate closed anastomosis.

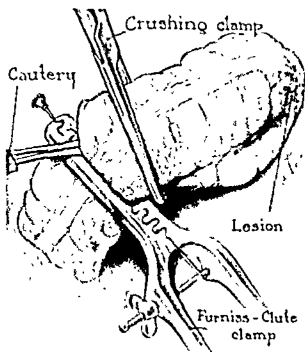


FIG. 606. Both loops of bowel have been approximated and Furniss-clute clamp applied. Cancerous bowel is clamped and discarded after division by cautery.

silk, in the anastomosis. Convincing is the report of Martzloff,[670] who, in a study of aseptic end-to-end intestinal anastomosis by clamp technic on 195 dogs, found that when silk was used throughout, failures occurred in 8.5 per cent of cases, whereas *where catgut was employed for one of the suture layers*, the incidence of failure was 23.5 per cent.

Open Method. The abdomen is opened in the usual fashion and the sigmoid mobilized in a manner previously described. In each instance, the left ureter is identified *and retracted. The blood supply to each* limb of bowel must be adequate. The portion of the bowel bearing the growth is divided between Payr clamps after rubber-guarded intestinal clamps are placed on the proximal and distal segments. Before the Payr clamps are removed, a black silk suture is introduced through the serosa at the medial and lateral borders to facilitate proper alignment. The *mucosal edges* are wiped with a 1:200 hydrochloric acid solu*tion and a continuous Connell stitch* inserted. Interrupted Lembert sutures to appose the serous surfaces are employed. After the patency of the bowel is assured, fat tabs are sewed over the anastomosis.

The *rent in the mesosigmoid is obliterated*, the packs removed, sulfathiazole crystals sprinkled over the viscera, a sump drain inserted into the pelvis for from 48 to 72 hours, and the abdomen closed in layers using *alloy steel wire. A complemental* appendicostomy or transversostomy may be instituted.

C. RECTOSIGMOIDECTOMY. During the past decade, resection of the lower sigmoid, rectosigmoid and upper rectum has been popularized by Dixon[294, 296, 297] (open anastomosis) *and by Wangensteen (closed* anastomosis) although the method was previously described by Crile[111] and Rankin. It is evident that with experience, either method may be performed with a mortality *rate that is low. The term "anterior* resection" is descriptive and well chosen. By such is conveyed the removal through the abdomen of a portion of the sigmoid, usually its lower portion, which may be extended to include the rectosigmoid and possibly the upper rectum. Resection con*notes re-establishment of continuity*, so that the remaining segments are anastomosed. Anterior resection, which was described by Rankin in 1928, offers the following advantages: it does not interfere with the sphincter muscle mechanism, it avoids sexual impotence in the male, and it does not require a *perineal step*. Only one five-year survival report is available, and therefore the *radicability is questioned by many.* One disadvantage is that anastomosis of parts devoid of serosa is frequently followed by infection and troublesome fistulae. More recently, Mayo and Smith[1110] selected two groups of 100 cases each with the following results:

Sigmoidectomy—open anastomosis 100 cases with colostomy—3 deaths—mortality 3%
Sigmoidectomy—open anastomosis 100 cases without colostomy—6 deaths—mortality 6%

PLATE 17



E. L., male, age 67. Rankin obstructive resection.



H. L., age 31. End-to-end anastomosis performed over Furniss clamp, and complemental appendicostomy.



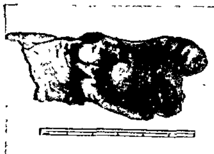
B. C., age 53. Sigmoidectomy performed by Wangensteen technic.



B. G., age 65. Resection with end-to-end anastomosis using Furniss-Clute clamp.



Sigmoidectomy—open anastomosis; complemental cecostomy.



J. S., male. Sigmoidectomy—immediate closed anastomosis.

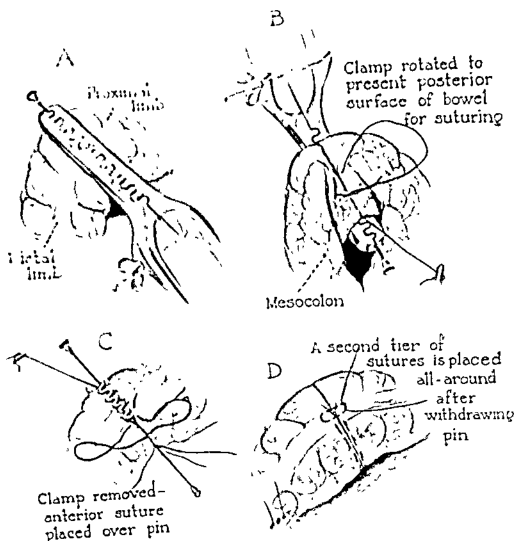


FIG. 607. Various steps in aseptic technic using Furniss-Clute clamp. Since illustration was made Lembert sutures are introduced in preference to mattress.

Except by those experienced with the technic, approximation by either the open or closed method is difficult deep in the pelvis, especially in obese persons. Our main criticism is that the levators cannot be removed by an abdominal approach, which is essential for complete radicality.

Technic. The abdomen is opened in the customary manner and the sigmoid mobilized by an incision carried in the left lateral gutter to a point behind and across the base of the bladder in the male or behind the posterior vaginal wall in the female. The left ureter is identified and retracted. An incision is carried in the medial leaf of the mesosigmoid parallel to the pelvic sigmoid to meet its fellow from the opposite side. The hand is introduced into the pelvis, thereby separating the rectum from the sacrum. Visceral forceps of the Babcock type are placed on the cut edge at the bladder base and elevated, after which, by blunt and sharp dissection, the rectum is freed from the seminal vesicles as far as the prostate in the male, or the upper portion of the posterior vaginal wall in the female. Thus far the procedure is similar to the abdominoperineal technic,

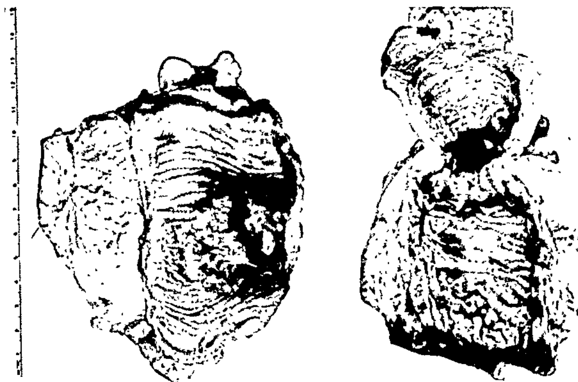


FIG. 608. (*Left*) L. S., female, age 67: resection over Furniss-Clute clamp, and complemental appendicostomy.

FIG. 609. (*Right*) C. F., female, age 45: sigmoidectomy over Furniss clamp, and complemental appendicostomy.



FIG. 610. A. S., age 76: organic stricture of the sigmoid due to carcinoma at junction at middle and distal third. End-to-end aseptic anastomosis performed with complemental appendicostomy. Adenocarcinoma, Grade III.

except that mobilization is not continued so far as the coccyx, but the lateral ligaments containing the middle hemorrhoidal vessels are necessarily divided. The distal segment will therefore derive its arterial supply from the inferior hemorrhoidal vessels. By transillumination, the superior hemorrhoidal vessels are ligated below the first sigmoidal branch so that adequate supply to the proximal segment to be anastomosed is assured. The portion of bowel containing the growth with adjacent lymph-node tissue is divided between clamps and removed from the operative field. From this point on, one may continue by either the closed or open method. In order to give credit, these methods will be designated accordingly as they are described in the following sections.

WANGENSTEEN TECHNIC. CLOSED METHOD. One anastomosis clamp is placed on the distal segment and the second on the proximal segment. The two Wangensteen clamps are opposed and the double ferrule substituted for the two single ferrules, after which the clamps are fastened in place with the locking device (Fig. 611). Interrupted

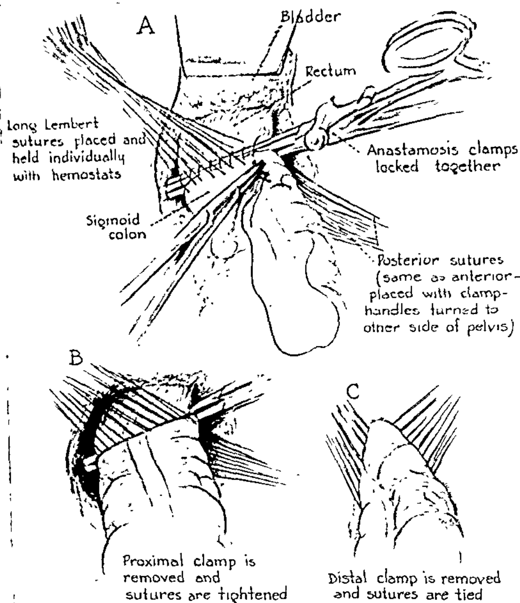


FIG. 611. Wangensteen technic of low end-to-end anastomosis.

Lembert sutures of triple No. 0 silk are introduced anteriorly and posteriorly. All sutures are held taut and the clamps removed. As each clamp is removed, the sutures are held taut, tightened and tied. A pelvic diaphragm is established by suturing the peritoneal flaps around the bowel above the anastomosis, so that it lies extraperitoneally. It is our custom to employ sulfonamide therapy, intra-abdominal drainage and surgical decompression. Following closure of the abdomen, a proximal vent may be established.

DIXON TECHNIC. OPEN METHOD. The procedure to the point of the anastomosis has been described previously. Having mobilized the entire segment, rubber-guarded clamps are applied and the bowel resected from the pelvic portion of the sigmoid flexure to the upper part of the rectum (Figs. 612, 614, 615). An open end-to-end anastomosis is established. Sulfanilamide

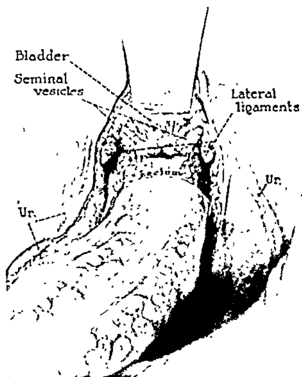


Fig. 612. Dixon. Sigmoidectomy—anterior resection. Sigmoid has been mobilized. Lateral ligaments divided which may or may not require ligation.



Fig. 613. L. S., age 67: opaque enema study showing large constant defect in sigmoid flexure. Adenocarcinoma, Grade II. Removed by end-to-end closed aseptic anastomosis with complemental appendicostomy. The patient was out of bed on the sixth postoperative day and was discharged on the eleventh.

(5 Gm.) is placed in the hollow of the sacrum and around the site of anastomosis. A Penrose drain is inserted along the sacrum and brought out through the lower end of the abdominal incision. The peritoneum is replaced immediately above the line of suture and the peritoneal leaves approximated by suture to the lateral and medial aspects of the bowel. The abdominal incision is closed and a transversostomy performed. The latter is opened in 24 hours and may be closed from three to six weeks later.

In Table 82 (p. 821), the use of surgical decompression proximal to the anastomosis is shown in the last column. Of interest are the 1941 figures contrasting the mortality with decompression and without decompression as tabulated by Gibbon and Hodge.[397]

Complications Following Rectosigmoidectomy. The author has found but few references upon which to base this discussion. Our experience with lesions in this site and by this method is sparse. Wangensteen[1022] has reported, "Whereas a temporary fistula occurred in the larger number of these cases, primary healing without evidence of fistula took place in 4 of 13 patients."

Local Recurrence. Regarding the incidence of local recurrence, the author has found but one report and again that by Wangensteen.[1022] "Of 22 patients surviving ampullary resection for rectal cancer, 5 had evidence of local recurrence. In 4 of these, ampullary resection was undertaken as a palliative procedure . . . two of these 5 patients had hepatic metastasis at the time of operation."

Survival Rate. Dixon[293] cited his experience in a group of 206 resections (rectosigmoidectomy), 181 of which were performed with a view toward cure, and 25 as a palliative procedure. Based on those for cure, namely 181 (less 22 hospital

TABLE 82. MORTALITY RATE FOLLOWING IMMEDIATE RE-ESTABLISHMENT OF CONTINUITY—OPEN AND CLOSED METHODS

AUTHOR	YEAR REPORTED	NO. CASES	OPEN	CLOSED	DEATHS	MORTALITY RATE	PROXIMAL COLOSTOMY
Cheever[213]	1931	.	..	..	..	18 %	
Finsterer[330]	1931	..	..	..	..	17 %	
Allen[11]	1939	52		52	6	11 %	
Allen[11]	1939	38	38	..	9	23 %	
Allen[12]	1947	100	..	..	2	2 %	No
Grinnell[424]	1939	..	..	..	..	27 %	
Allen[10]	1943	86	..	86	11	12.7%	Yes
Jones, T.[509]	1943	128	..	..	..	14 %	Yes
Rankin[838]	1942	2	..	..	1	50 %	
Stone & McLanahan[965]	1942	72	19	53	7	9.7%	
Gibbon & Hodge[397]	1941	24	0	24	3	13 %	
Gibbon & Hodge[397]	1941	21	21	0	8	38 %	
Dixon[293]	1944	206	181	..	22	14.5%	Yes
Wangensteen[1021]	1943	46	..	46	1	2.1%	No
Zinninger & Hoxworth[1079]	1943	18	0	18	2	11.1%	
Wilkie[1057]	1939	95	0	95	15	16 %	
Fallis[336]	1943	31		31	2	6.5%	Yes
Baker[72]	1944	9	0	9	1	11.1%	Yes
White & Amendola[1046]	1944	36	8	28	4	11.1%	Yes
MacFee[645]	1937	56	0	56	..	16 %	
MacFee[645]	1937	32	32	0	..	19 %	
Hayden[456]	1945	13	?	?	3	23 %	
Pierpont[805]	1945	21	?	?	?	19 %	
Coller & Vaughan[239]	1945	51	?	?	1	4.7%	Yes
Wangensteen[26]	1945	76	0	76		7.6%	No
Clute & Kenney[227]	1945	8	0	8	0	0	No
McMillan[700]	1946	27	27	0	1	3.7%	
Babcock[26]	1946	51		51	2	3.9%	No
Meyer & Kozoll[708]	1946	25	25	0	1	4 %	No
Waugh & Custer[1029]	1946	50	16	34	2	4 %	No
McNealy & Lands[701]	1947	34	34	0	2	5.8%	No
Woolf[1065]	1942	3	?	?	?	0	Yes
Johns[1112]	1947	39		39	0	0	
Best[1108]	1948	8	.	..	.	7.6%	
McKittrick[1107]	1948	79	..	..	6	7 %	
Dixon[1115]	1948	426	426	..	25	5.9%	Yes
Waugh[1028, 1109]	1948	197		..	..	5.5%	No
Hinton[1089]	1948	26		..	1	3.8%	No
Bacon (Group A)	1948	32	5	27	3	9.3%	Yes

deaths), 60 of the 102 patients traced were alive at the end of three years, or 58.8 per cent.

Quite recently, Waugh[1028] stated that Dixon reported an incidence for five-year cure of 67.7 per cent (see Chart on p. 824)

TYPE OF OPERATION	DECOMPRESSION		NO DECOMPRESSION	
	NO. PATIENTS	MORTALITY	NO. PATIENTS	MORTALITY
Aseptic anastomosis	8	13%	16	13%
Open anastomosis	12	25%	9	56%

(GIBBON AND HODGE)

A

Bladder

B

Seminal vesicles

Rectum

C

Sigmoid

Blad.

D

Reflection of peritoneum

Anastomosis extraperitonealized

Fig. 614. Dixon method of low anastomosis.

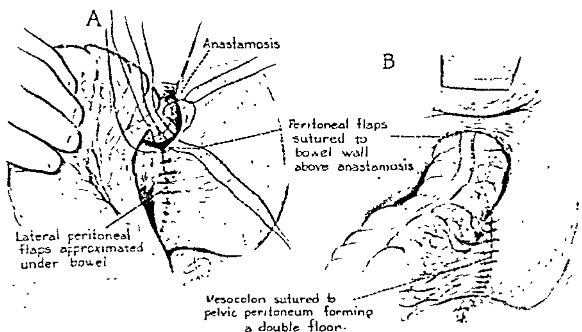


Fig. 615. Dixon. Anastomosis is extraperitonealized and edges of peritoneum tacked to bowel.

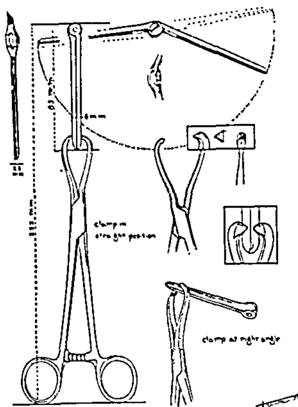


Fig. 616. Stone clamp.

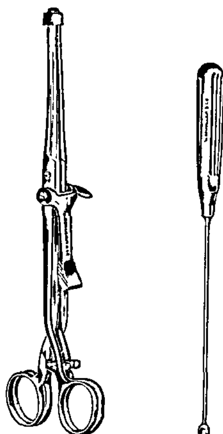


Fig. 617. (*Left*) Wangensteen clamp. (*Right*) Wangensteen pusher.



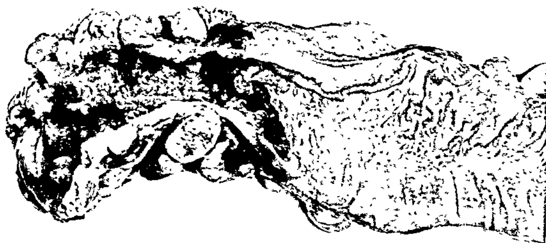


Fig. 618. Carcinoma of low sigmoid resected with immediate establishment of continuity.

in a group of *272 anterior resections* performed at all levels. It should be mentioned, however, as stated, that these resections were *instituted for cure. Therefore* palliative cases have been excluded.

To the author, none of whose anterior resections have passed the five-year mark, it appears that low anastomoses for cancer involving the midrectum and low rectum must of necessity carry with them an above-average incidence of local recurrence, inasmuch as the levators cannot be excised widely, which is essential to remove the lateral mode of spread. In this respect, proctosigmoidectomy presents an advantage, since wide removal of the levators is possible. That wide and lateral removal cannot be effected in extirpation of low-lying cancer from an abdominal approach (anterior resection) is borne out by a recent report by Wangensteen.[1023] His incidence of local recurrence at various levels is shown in Table 83.

ANTERIOR RESECTION: NONPALLIATIVE OPERATION: FIVE-YEAR SURVIVAL RATES FOR DIFFERENT LEVELS (DIXON), 1930-1947

Distance from Dentate Line	All Cases: Number	All Cases: Per Cent Survival	Nodes Not Involved: Cases	Nodes Not Involved: Per Cent Survival	Nodes Involved: Cases	Nodes Involved: Per Cent Survival
6-10	74	63.7	32	72.4	42	57.1
11-15	97	70.2	58	78.8	39	57.7
16-20	101	66.9	60	71.5	41	60.4
All levels	272	67.7	150	74.0	122	58.5

Comment. Even though the writer is loath to accept an operation for low-lying cancer without removal of the levators, it must be admitted by me as well as the opponents to sphincter-preservation procedures that a survival rate of 67.7 per cent for five years and 49.8 per cent for ten years as achieved by Dixon[1115] is without comparison as judged by all available data.

D. SIGMOIDECTOMY OR RECTOSIGMOIDECTOMY WITH PERMANENT ABDOMINAL COLOSTOMY (HARTMANN). *Description.* This procedure consists of removal of the sigmoid and may be extended to include the rectosigmoid and upper rectum. The pelvic colon is mobilized; the bowel is doubly clamped below the growth, divided and the lower end or rectal stump closed and extraperitonealized; the upper segment containing the growth is drawn through the abdominal wound. The bowel well above the growth is doubly clamped and divided—the upper portion to serve as a permanent colostomy.

Use of the term "anterior resection" as frequently employed to describe this operation is confusing, and inasmuch as bowel continuity is not re-established, it is incorrect and therefore should be omitted. One of the first to describe this procedure was Cripps,[248] in 1907. A group of four cases was reported by W. J. Mayo[689] a few years

TABLE 83. CARCINOMA OF THE RECTUM AND LOW PELVIC COLON (WANGENSTEEN)

Distance in Cm. from Anus	No. Cases	No. Cases of Recurrence	Per Cent of Cases	Per Cent of Total Local Recurrence
	Cases of Local Recurrence in the Curative Group			
0- 5 cm. incl.	7	2	30	30
6- 8 cm. incl.	12	3	25	40
9-13 cm. incl.	32	2	6.3	30
14-20 cm. incl.	12	0	0	0
Total	63	7	14	100



FIG. 619. P. B., rectosigmoidectomy (Hartmann method).

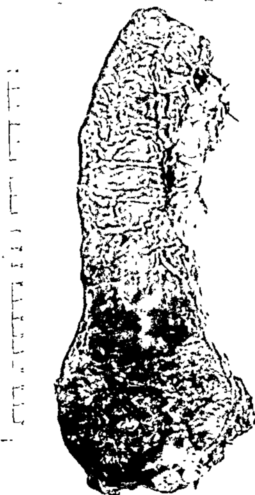


FIG. 620. M. M., female: specimen removed by Hartmann technic.

later, but because of the popularity accorded Hartmann in 1923,[418, 419] the operation is usually designated by his name.

Technic. The abdomen is opened through a left paramedian incision, and the small bowel walled-off with hot packs. Mobilization of the sigmoid is begun by incising the peritoneum in the lateral gutter, during the course of which the left ureter is identified and retracted. The incision is carried downward to and across the base of the bladder in the male or behind the vagina in the female. A similar incision is carried in the medial leaf of the mesosigmoid parallel to the bowel to the rectovesical or rectouterine sulcus to meet its fellow from the opposite side. The hand is introduced into the cellular space behind the rectum to a sufficient depth required for mobilization. By elevating the cut edges of peritoneum anteriorly with Babcock visceral forceps, the rectum is separated from the posterior vaginal wall or from the seminal vesicles by sharp and blunt dissection. Usually the lateral ligaments are divided. The degree of mobilization will depend, however, on the precise location of the growth. The superior

hemorrhoidal vessels are doubly clamped, divided and ligated, but viability to the segment of bowel which shall serve as the permanent colostomy must be assured. By holding taut the mobilized sigmoid, two right-angled clamps of the short Mikulicz or Pemberton type are placed at least three centimeters below the growth and divided with the cautery. Temporarily, the long, mobilized sigmoid containing the growth is wrapped in a hot towel and drawn through the abdominal incision. Attention is now directed to the clamped rectal stump, which is closed by suture over the clamp. The latter is withdrawn and a purse-string suture introduced. Sulfathiazole powder is sprinkled over the blind stump, which is extraperitonealized by re-establishing the pelvic floor. A long, perforated metal sump drain is inserted into the pelvis behind the stump and the peritoneum closed around it.

The long loop of mobilized sigmoid containing the growth is inspected for the point of division. At the site selected, two Ochsner clamps are applied and the bowel divided between. The proximal segment will serve as the permanent colostomy. The portion



Fig. 621. R. B., male: specimen removed by Hartmann technic.



Fig. 622. Carcinoma of low sigmoid.



Fig. 623. Carcinoma of low sigmoid removed by Hartmann technic.

containing the growth is removed from the operative field. After the raw areas are peritonealized, sulfathiazole crystals (2½ Gm.) are sprinkled over the viscera. The metal sump drain extending into the presacral space is held in the lower angle of the abdominal wound and the proximal segment of bowel drawn through at its upper angle. The incision is closed in layers. The care of the colostomy is similar to former discussions in the use of the Daniel's clamp and mushroom catheter, which is irrigated every four hours beginning the day following operation. The colostomy (permanent) may be placed in the upper angle of the exploratory incision or drawn through a stab wound in the left lower quadrant.

Survival Rate. Of seven cases followed, Hartmann found that five were living and well from 2½ to 10 years after operation. Of eleven cases reported by Gabriel, four of which were resected more than 5 years, one lived 9 years, one died 2 years later of recurrence, and two remained untraced. Muir and Norbury cite recurrences in the rectal stump.

Comment. The Hartmann operation should not be considered a substitute for the more reliable methods of extirpation. It is generally considered to be less radical, although, if one chooses, the rectal stump may be subsequently removed by the perineal route. Such, however, would entail a two-stage maneuver and necessarily should be designated "abdominoperineal excision." (See discussion by Dixon[1117] and Clark.[1118]) The disadvantages attached to the operation are infection from the rectal stump and the development of secondary carcinoma therein.

Our purpose in describing the operation is that it has served of value in a small group of eighteen cases. Because of factors developing during operation (such as shock incident to anesthesia or hemorrhage) which occur in patients previously considered bad risks and for whom a more formidable procedure was justifiably unwise, the technic has proved of value (see Table 84, p. 828).



Fig. 624. Midampullary growth removed by Hartmann procedure in poor risk patient.

Complications and Sequelae of Resections in General. This subject will be found discussed in detail under "Preoperative and Postoperative Treatment," Chapter 28.

Consecutive Resections without Mortality. A few reports are available pertinent to consecutive resections without a single death. These are appended as follows:

Author	No. Consecutive Resections	Mortality Rate
Allen[12]	87	0
Babcock[40]	69	0
Binkley & Deddish[132]	130	0
Jones[510]	137	0
Bacon[1085]	145	0

In our department, from the middle of January, 1946, to May, 1947, the author

TABLE 84. RECTOSIGMOIDECTOMY (HARTMANN)

AUTHOR	YEAR REPORTED	NO. PATIENTS	NO. DEATHS	MORTALITY	DRAINAGE
Hartmann[418]	1923	34	3	8.8%	None
Rankin[841]	1928	28	1	3.5%	Vaginal or abdominal
Pierpont[805]	1946	14	0	0	
Cattell[109]	1943	17	4	23.5%	
Muir[741]	1939	9	0	0	
Woolf[1065]	1942	10	0	0	
Hayden[456]	1945	16	4	25 %	
Gabriel[378]	1945	11	0	0	None
Bacon (Group A)	1948	18	2	11.1%	Abdominal sump drainage

performed 145 consecutive resections of the rectum and/or sigmoid without a single death. It can be stated unequivocally that these results were achieved only by means of a meticulous preoperative routine of preparation, expert administration of anesthesia and a precise, closely supervised postoperative regime by the residents, assistants and nursing staff, together with the co-operating allied departments.

OPERATIVE MORTALITY. Although the mortality rate from each type of resection has been tabulated under the respective technics, the cause of death for our entire series of cases in Group A is appended as follows:

TABLE 85. CAUSE OF DEATH IN 638 RESECTIONS OF RECTUM AND SIGMOID (AUTHOR'S SERIES)

CAUSE	NUMBER DEATHS	MORTALITY RATE
Peritonitis	13	....
Pulmonary embolism	6	.
Myocardial failure	3	
Cerebral thrombosis	2	
Obstruction and pneumonia	1	
Obstruction	1	
Uremia	3	
Diabetic coma	1	.
Shock	1	.
Hemolytic transfusion reaction	1	
Anesthesia (autopsy)	1	.
Total	33	5.1%

SUMMARY

It has been the purpose of the author in the immediate preceding pages to evaluate the surgical management of cancerous lesions of the lower bowel in an impartial and unbiased fashion. Lest misunderstanding accrue regarding our approach to the problem of cancer in these sites, the following may serve for clarification:

A. All lesions of the middle and upper thirds of the sigmoid have been resected by:
   1. Immediate establishment of continuity either by the closed or open technic,

   or

   2. Mikulicz - Rankin exteriorization method.

B. All lesions of the lower third of the sigmoid, rectosigmoid and ampullary rectum (lowest 3 cm. of rectum excluded) have been extirpated by:
   Abdominoperineal proctosigmoidectomy without colostomy and with preservation of the internal and external sphincter musculature.

C. All lesions of the low rectum (lowest 3 cm. of rectum) and anal canal (3 cm.), total 6 cm., have been removed by:
   Abdominoperineal excision (Miles technic).

For particularly poor risk patients with malignancy of the anal canal and low rectum, colostomy and posterior excision (Lockhart-Mummery) may be chosen; while for sigmoidal growths under unusual circumstances, sigmoidectomy with permanent colostomy (Hartmann) may be selected.

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CHAPTER 20

Colostomy, Transversostomy, Cecostomy, Appendicostomy, Ileostomy

COLOSTOMY

Definition. Colostomy is the establishment of an artificial opening in some portion of the colon. The term is somewhat indefinite, in that it represents an aperture in any portion of the large bowel. Terms such as sigmoidostomy (sigmoid) or transversostomy (transverse colon) are more descriptive. A colostomy may be temporary or permanent and either single or double-barrelled in type. Independent of its type or location, the purpose is to divert the current of feces.

Colotomy. Where the bowel is slit or incised, as for the removal of a foreign body or benign polyp, the term colotomy (Sigmoidotomy, see p. 558) is employed. Immediate closure is inferred.

Historical Sketch. The first recorded reference to colostomy appears in the report of Dantanelle, in 1710, to the Academie Royale des Sciences, wherein the historian described the method suggested by Littré[53] for the treatment of imperforate anus. In these early years the procedure was called colotomy, in accordance with its literal meaning, to cut the colon. With the advent of different methods, this term became too narrow, and the more descriptive "colostomy" was substituted, meaning a mouth, or opening for the colon.

Littré, in performing an autopsy on a child six days old which had been born with a malformation of the rectum, conceived the idea of opening and suturing both ends of the divided rectum, or at least bringing the proximal portion to the abdominal wall, thereby forming an external opening.

It is not recorded that Littré himself ever performed such an operation, however, and practical use was not made of this brilliant suggestion until, sixty-six years later, when Pillore[75] of Rouen performed a cecostomy for the relief of rectal obstruction caused by cancer.

It is recorded that, in 1783, Duboise performed a colostomy, but not until ten years later was a successful case reported. With the case of Duret[24] of Brest, a naval surgeon who performed a lumbar colostomy on a child three days old with imperforate anus, the recognized practice of this procedure began, and with its practice came its evolution from improvement to improvement, together with a widely extended field of applicability. He brought the sigmoid colon through a very small incision placed obliquely between the last rib and the iliac crest, and sutured the mesocolon to prevent the bowel from receding. In this he preceded Allingham[2] by over ninety years, but it was the latter who popularized and received credit for this modification.

In 1794, Desault[18] used this operation for imperforate anus, and in 1797, Fine,[27] in performing a colostomy, accidentally formed a colonic stoma by making an incision above the umbilicus in the linea alba, for the purpose of opening the small bowel for relief of obstruction.

In the meantime (1796), Callisen,[9] working independently in Copenhagen, conceived the

same idea as Duret, and performed a lumbar colostomy, believing that the intestine could be reached more easily from this site than through Littré's iliac incision. Neither surgeon, however, realized the value of his procedure nor advocated it very strongly, for which reason it did not attract much notice until the time of Amussat. In fact, Callisen, in performing the operation at autopsy, injured the peritoneum and abandoned the idea as impractical.

In 1815, Freer[29] of Birmingham performed the first colostomy in England, using the left iliac approach.

The next report came from Daniel Pring[77] who reported in detail a left iliac colostomy for the relief of obstruction due to rectal cancer.

As may be noted from the intervals between these operations, the operation had not yet taken its place in routine surgery; in fact, it was looked upon more or less as an adventure into the unknown, a heroic attempt to do the impossible, or a last resort to save life. In 1839, Amussat[3] of Paris removed the mystery from colostomy by tracing its history, proved its feasibility in his dissecting laboratory and established its practicability by using it routinely in the operating room. One of the reasons for his success in popularizing this operation was that he contended that peritonitis, to which he attributed every fatality attendant upon this operation, could be largely avoided by the use of the lumbar colostomy, performed outside the peritoneum. As a result, Littré's method fell into discard for the next half century and Duret's procedure came into its own. Its reign was comparatively brief for obvious reasons.

Naturally, with increased usage, various modifications of the abdominal colostomy arose. In 1850, Luke employed a pararectus incision and brought the bowel out in the region of the rectus muscle. The same year Adams released the bowel through the linea alba by means of a hypogastric incision. In the last quarter of the 19th century great strides were made, not only in this but in all forms of surgery, owing to the development of antisepsis. The effect of asepsis on colostomy was to make it practicable to approach through the abdominal route, by which method the field of applicability was still further widened and the colostomy could be made more accessible and more readily controllable.

In spite of its flourishing acceptance on the continent and in England, this operation received no favor in America. In 1864, Gross[34] declared that it "ought to be discarded as among the obsolete devices of surgery." Not until the next century did American surgeons make any earnest study of its possibilities, but when they did turn their attention to it, they produced a refinement of technic and comfort to the patient that rendered colostomy a successful and satisfactory procedure.

Among the many who, between 1875 and 1900, suggested practical modifications, William Allingham[2] stands out as the inaugurator of the peritoneal approach, which he called "inguinal colotomy." In 1888, he published a treatise in which he reviewed the methods of Luke, Reeves, Studsgaard, Madeling and Verneuil, then detailed his own procedure. He made a short incision about one inch inside the anterior superior spine of the ilium and parallel with Poupart's ligament and sutured the parietal peritoneum to the skin edge. The sigmoidal loop was supported by sutures passed through the gut wall, originally Duret's idea but now for the first time to become popular. Allingham emphasized the importance of fastening the gut well outside the wound in order to obtain a good spur. He believed that "if the spur fails . . . the operation is itself a failure." In this, many of his contemporaries concurred, notably Cripps, Kelsey, Bodine, Reclus, Reeves, Maydl and Herbert Allingham. Maydl,[59] in 1888, suggested passing a vulcanite rod through the mesocolon, which device is still in common use in this country. In 1889, Kelsey of New York also put forth an individual method of preventing recession and securing a spur.

Other suggestions of the period included Schitzinger's (1881) device of practicing complete division of the bowel with closure of the distal end, which was allowed to fall back into the abdomen, while the proximal end was secured to the abdominal wall. Senn followed this procedure in America. In 1884, Polloson[76] suggested temporary diversion of the fecal current, but the idea was not put into practice until 1887, when Schede[92] employed it. A most fruitful advance in technic made at this time was the evolution of a method of forming the stomata so that they could be closed later without again opening the peritoneum, which latter procedure had thus far been the only one in use and had proved fatal more often than the original operation. This removed the greatest obstacle to employing colostomy in other than incurable conditions. To prevent retraction of the bowel into the abdomen, suture of the peritoneal coat of the bowel to the skin margin was practiced. Ball[5] advised passing

heavy through-and-through sutures from the skin on one side underneath the bowel to the skin on the other side. Mathews[58] devised a long, hatpin-like type of metal support to be passed beneath the sigmoid.

Mixter advocated the flap method, which consisted of an incision from about the level of the umbilicus to a point over the outer third of the left rectus sheath, through the skin and superficial fascia only. After retraction of the skin flap laterally, the rectus sheath and muscle were incised and the peritoneum opened. The sigmoid was delivered and the mesosigmoid incised at right angles to the long axis of the bowel for a distance of two inches. All the layers were then sutured between the two loops, through the rent in the mesosigmoid, and the skin flap was pulled through the incised mesosigmoid and sutured, thus separating the two limbs widely.

Rankin's[62] technic is identical with the classical one, except that the peritoneum, muscles and skin are sutured layer by layer between the two limbs. Another addition to the procedure, for which he gives Littlewood credit, is to obliterate the left lateral peritoneal gutter by passing a purse-string suture between the mesosigmoid and the parietal peritoneum at the level of the colostomy, thus preventing strangulation of the small bowel lateral to the colostomy.

In Mayo-Dixon's[60] technic the approach is inguinal, but after the loop of bowel is delivered, the mesosigmoid is incised and the peritoneum and muscles are sutured by layers between the two limbs of the loop. A skin flap is made by cutting medially from the upper extent of the original incision for half its total length; then the flap is pulled through the two limbs of the sigmoid and sutured to the opposite side, thus separating the two limbs. On the third or fourth day, the loop is opened halfway through its convex surface, and about the seventh or eighth day, the whole loop is removed.

Indications. Colostomy has its greatest applicability in any acute complete obstructive process of the colon, rectum or anus, whether the causative factor is of embryologic, inflammatory, mechanical or neoplastic origin. Obstruction, therefore, must be regarded as a definite contraindication to resection and primary anastomosis. The establishment of such an artificial stoma is required in many types of operation, such as colostomy and posterior excision (Lockhart-Mummery, see p. 773), as a part of the abdominoperineal excision popularly known as the Miles operation (see p. 769) and as an initial step of the two-stage excision of Lahey (see p. 784), which is now but seldom employed. Aside from many other operative technics of which it is an integral part, colostomy may serve well its purpose of fecal diversion in cases of extensive ulcerative processes of the distal bowel; in extensive cellulitis and gangrenous periproctitis, in the presence of marked intraluminal narrowing of the rectosigmoid due to endometriosis; in cases of compression and/or extension of extrarectal neoplasms, as well as marked narrowing due to radiation therapy; in destructive injuries of the anorectum and colon where incontinence exists as a result of previous operation, injury or tabes dorsalis; in certain cases of multiple or complicated complex fistulae (see p. 195, Chap. 7, Fistula); and in congenital absence of the rectum or where the blind pouch is located at a high level (see Chap. 3, Malformations, p. 85).

There are definite indications for colostomy, both temporary and permanent, and for any surgeon to state that such should never be performed is quite ridiculous. Benefit to the patient is and should be the prime consideration in each and every instance. Our attitude is simply that colostomies are too often performed unnecessarily. During the past decade, there has been a renewed interest in and tendency toward the avoidance of an artificial abdominal stoma, either temporary or permanent, where lesions of the bowel can be more satisfactorily corrected by other radical procedures without a colostomy as an integral part.

Specifically, the writer refers to such procedures as proctosigmoidectomy for lesions of the ampullary rectum and rectosigmoid, and immediate establishment of bowel continuity for those of the colon. This subject,

together with the author's approach to the question of colostomy, has been discussed in Chapter 19, Part 3, page 725, in some detail.

Advantages. There is no doubt that the life of a patient after colostomy is restricted and distasteful, but in many instances its drawbacks are not to be compared with its benefits. This procedure, which can be performed practically without risk, offers many advantages, although the degree of relief varies greatly with individual patients. By the establishment of a colostomy, obstruction is relieved or prevented, the distressing discharges are diminished, and tenesmus is lessened. Bleeding may be decreased, while gaseous distention and pain may subside. In some instances, dependent upon the underlying cause, digestion and general well-being improve while the patients' weight may increase. In a few instances, we have resorted to interstitial implantation of radium through the lower loop of the colostomy in inoperable malignancy, as well as fulguration of adenomatous polyps. Irrigation through the lower loop is likewise permissible. Much has been written relative to the protection afforded by the establishment of a colostomy. Suffice it to state that it is generally accepted that such protection is not due entirely to peritoneal "immunity," as determined by agglutination titer of the serum against the *Bacillus coli communis*. Physical factors secondary to the colostomy, such as intraperitoneal adhesions, etc., undoubtedly play an important role.[13, 70, 72, 87, 100]

Disadvantages. The unnatural location of the opening, inability to control the fecal evacuations, escape of flatus and mucus, soiling of the clothing, soreness and irritation of the abdominal skin, embarrassment during intercourse, bleeding from the colostomy mucosa, inequality of the abdominal wall due to dressings, bags and bulging due to dressings, bags, cups and other cumbersome paraphernalia, are all distinct disadvantages. The fact must be appreciated, however, that a colostomy established as an integral part of resection does not possess all the disadvantages of one performed for palliation.

Sigmoidostomy, or Left Inguinal Colostomy

The simplicity of this procedure commends it.

There has evolved a classical procedure which is employed almost routinely because it possesses many advantages without the disadvantages of the several preceding methods already described. It is performed through a muscle-splitting intramuscular or gridiron incision. This approach is identical with that of the McBurney or McArthur incision for appendectomy except that it is made on the left side of the abdomen.

Technic. An incision approximately three inches in length is made with its center cutting at right angles an imaginary line drawn between the anterior superior iliac spine and the umbilicus (Fig. 626a). This places the deep incision parallel to the skin incision. The sigmoid is found readily by passing the finger along the lateral wall and then medially. After it has been identified by its anatomic position, longitudinal bands and sacculations, the sigmoid is drawn out of the incision as far as its mesosigmoidal fixation will allow. Where the colostomy is to be permanent, the highest point that can be obtained should be selected in order to prevent prolapse of the proximal loop. Ordinarily, the portion of bowel just distal to the iliac sigmoid is utilized.

With the bowel withdrawn well beyond the skin margin, a small incision perpendicular to the axis of the gut is made in an avascular area of the mesosigmoid. A rubber tube is passed through and retained for traction on the bowel only during the remainder of the procedure. Parker retractors are placed in each end of the wound and closure begun.

Where the colostomy is to be permanent,

a larger slit in the mesosigmoid is necessary so that the abdominal wall may be sutured between the two loops: first the peritoneum is stitched together with two interrupted sutures of No. 0 chromic catgut; the fascia is then *approximated with No. 32 alloy steel* wire and finally the skin with No. 35 alloy steel wire. In other words, from approximately one half to three quarters of the entire abdominal wall is closed between the proximal and distal bowel loops. The remaining open wounds above the proximal loop and below the distal loop are closed using No. 0 chromic catgut for the peritoneum; No. 32 alloy steel wire for fascia, and No. 35 for skin. It should be remembered that the wound is better too loose than too tight, since constriction may impair the *blood supply. A good index to* determine just how much space to leave or how tight to make the closure is to be *able to insert easily* both index fingers to the sides of the extruding bowel loops (McCarthy). At this point, the surgeon must decide whether the bowel should be divided immediately or later.

A. IMMEDIATE. The incision is covered with dressings and the knuckle of protruding *bowel divided by cautery*. A rubber tube or even a glass Paul tube may be tied in the proximal loop. An alternative is to introduce a purse-string suture of silk in the bowel, and insert a perforated rubber tube through a slit. More recently it has been our custom to divide the bowel completely and introduce a mushroom catheter into the proximal loop, which is held in place by a Daniel's clamp (see p. 747). This permits *immediate instillation and irrigation.*

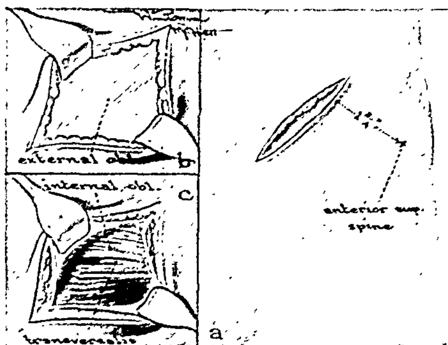


FIG. 626. Technic of performing (gridiron) inguinal colostomy. (a) Site of skin incision. (b) Skin edges retracted to expose external oblique; this is then slit and retracted to expose the internal oblique. (c) the fibers of the internal oblique have been separated. Note transversalis at the site of separation.

B. DELAYED. Ordinarily, the bowel is divided by cautery at the expiration of 48 *hours, when the reparative processes should* be well established.[85] In all instances, petroleum jelly gauze is wrapped about each bowel loop.

Where the colostomy is to be temporary,

the bowel is delivered into the wound and a small slit made in an avascular site of the mesosigmoid. A rubber tube is inserted similarly for traction. The peritoneum above and below the bowel loops are sutured, as truding bowel and slipped onto the opposite end of the glass rod (Maydl technic). Inasmuch as no sutures are ever placed between the bowel and any portion of the abdominal wall, it is better to divide the

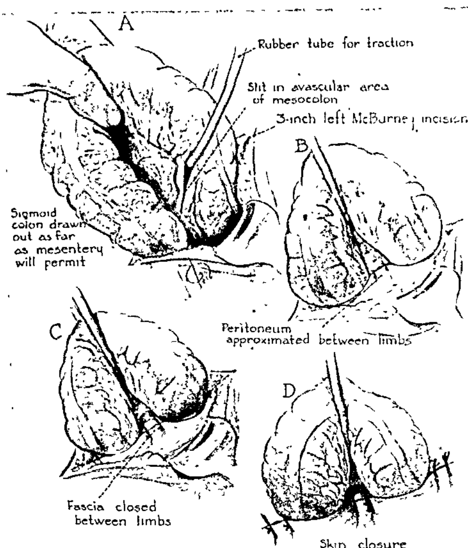


FIG. 627. Steps in the performance of a sigmoidostomy. Steel alloy wire is used for all layers.

are the fascia and skin, using the same suture material previously mentioned. A glass rod with rubber tubing attached to one end is substituted for the rubber traction tube and allowed to rest upon the gauze-covered skin surface. The free end of rubber tubing is then passed over the pro- bowel at the expiration of 48 hours. If, however, an immediate decompressive vent is required, a purse-string suture is inserted, the bowel slit, a tube introduced into the proximal loop and tied in place.

This abdominal type of stoma, described under Temporary Colostomy, is usually

designated as a "loop colostomy." While subsequent closure is more easily accomplished, it does not achieve complete diversion of the fecal stream.

Other methods advocated have not been described because of limitation of space. The reader, however, may find recourse to the original articles here designated.[4, 25, 35, 43, 49, 52, 59, 60, 82, 99]

Perhaps a word would not be amiss relative to the position of the sigmoidostomy. The left lower abdomen through a muscle-splitting incision is, and has been, the site of choice of most surgeons, for obvious reasons. Placing the permanent stoma in the exploratory wound has been frowned upon, largely because of the resultant weakness of a midline, paramedian or rectus incisional wound. Contamination of such an incision from the contents of the colostomy, dehiscence and herniation are additional reasons. Until two years ago, it was our custom to employ the left McBurney incision for the artificial stoma, utilizing the left paramedian approach for the exploration and resection. Since that time, in cases where a colostomy must serve as an integral part of the resection, the colostomy is placed in the upper angle of the paramedian incision. Our results have been highly satisfactory, but we are convinced that the use of alloy steel wire and other methods previously referred to (see Chap. 29, Alloy Steel Wire) have contributed much to the results obtained.

Umbilical Colostomy

Hirschman[41] has been an advocate of placing the colonic stoma at the umbilical site. It is his opinion that the central location is advantageous because of abdominal wall strength and more natural opening. The umbilicus is always excised so that the colostomy is drawn through this site.

Precolostomy

Where abdominal exploration has proved the case to be inoperable, the surgeon is and should be reluctant to divert the fecal stream and establish a colostomy where the bowel is not obstructed. There may arise occasions when one hesitates to subject the patient to another operative procedure at a later time, for which Stone[101] recommends what he terms a "precolostomy" procedure. Here, a small left McBurney incision is made and the sigmoid drawn through the wound until about one fourth of the circumference extends beyond the skin level. The loop is then loosely anchored to the skin with a few interrupted sutures. Thus is produced a small ventral hernia containing the attached loop of sigmoid, which may be instantly opened at any time without anesthesia.

Postoperative Treatment

The regime described under Preoperative and Postoperative Treatment of major lesions (Chap. 28), is instituted when nutritional, fluid and acid-base balance, the position of the patient in bed, movements of the limbs and use of suction are concerned.

When the bowel (colostomy) has been divided at the time of operation. Warm olive oil is instilled into the colostomy loop through the mushroom catheter held in place by the Daniel's clamp (see Malignancy, Chap. 19, p. 774). Thereafter, at four-hour intervals, from two to four ounces of warm saline solution alternating with 15 per cent hydrogen peroxide are used. Dressings are changed daily and the skin and incision cleansed with alcohol. Gauze saturated with tincture benzoin is placed on the incision, while a mineral oil dressing is loosely wrapped around the loop or loops. With the first fecal evacuation, usually within 48 hours, a soft diet is given. Irrigation of the lower loop (if one has been established) is begun, using potassium permanganate 1 to 8000, or, preferably, a suspension of sulfathalidine, from two to four times daily, depending upon the local pathologic process. A house diet is prescribed as soon as the condition of the patient permits, usually the fourth postoperative day.

Wire skin sutures are removed between the fifth and seventh day.

When the bowel (colostomy) has not been divided. Usually, following a 48-hour period, the protruding loop of bowel is elevated or held taut and divided transversely to the long axis of the bowel. Usually only the anterior surface of the bowel is divided when the colostomy is a temporary procedure, although, if one desires, the bowel may be divided completely through the wall, thus liberating the glass rod if one has been used (see Fig. 629). Ordinarily, we employ the surgical diathermy for division of the bowel and coagulation of bleeding points. The treatment otherwise is the same as described.



Fig. 628. Midline colostomy.

Management of the Colostomy

Patients invariably exhibit a great aversion to a colostomy. To some measure this is due to lack of explanation and incomplete instruction by the attending physician. A prime requisite in all instances is a properly placed and well constructed stoma, which, of course, is the responsibility of the surgeon.

To control the colostomy, the efforts of both patient and physician must be united in carrying out certain measures. Only too frequently the physician is indifferent to the situation, and as a result his colostomized patients, owing to neglect of essentials, resign themselves to lives that have become mere existences, and miserable ones at that. To permit the individual to live an active life in relative comfort, certain measures, such as encouragement, regulation of the diet and irrigation, must be instituted. To this end, precision and punctuality are of utmost importance. The patient should be trained to evacuate once or, if necessary, twice a day at the same time as the customary movement before operation. One or even two small irrigations of the proximal bowel with physiologic saline solution may be necessary to induce a normal and satisfactory routine movement. This irrigation should preferably be effected about a half hour after breakfast.

Diet. Selection of food, the liquid allowance and the intervals of eating are important in establishing a formed, regular stool. By attention to these points, a too soft or liquid stool can be avoided; in addition, the patient becomes familiar with the sensations which warn him of impending movement. Ordinarily, the colostomized individual discovers that a degree of constipation enables him to reduce the number of evacuations to one or two a day, and

BREAKFAST	DINNER	SUPPER
Orange juice, ¼ glass	Meat, 1 serving	Cheese, 1 serving
Bland cereal, 1 serving	Potatoes, 1 serving	Meat, 1 serving or two eggs
Bacon or egg	Shredded lettuce, 1 serving	Potato or substitute
Toast with butter	Bland dessert—no fruit	Bland dessert or ripe banana or bland fruit
Coffee if desired	Bread, toast or crackers with butter	Bread, crackers or zwieback with butter
Cream	Jelly	Jelly
Brewer's yeast	Milk, boiled, 1 glass	Milk, boiled, 1 glass
	Brewer's yeast	Brewer's yeast

designated as a "loop colostomy." While subsequent closure is more easily accomplished, it does not achieve complete diversion of the fecal stream.

Other methods advocated have not been described because of limitation of space. The reader, however, may find recourse to the original articles here designated.[4, 25, 35, 43, 49, 52, 59, 60, 82, 99]

Perhaps a word would not be amiss relative to the position of the sigmoidostomy. The left lower abdomen through a muscle-splitting incision is, and has been, the site of choice of most surgeons, for obvious reasons. Placing the permanent stoma in the exploratory wound has been frowned upon, largely because of the resultant weakness of a midline, paramedian or rectus incisional wound. Contamination of such an incision from the contents of the colostomy, dehiscence and herniation are additional reasons. Until two years ago, it was our custom to employ the left McBurney incision for the artificial stoma, utilizing the left paramedian approach for the exploration and resection. Since that time, in cases where a colostomy must serve as an integral part of the resection, the colostomy is placed in the upper angle of the paramedian incision. Our results have been highly satisfactory, but we are convinced that the use of alloy steel wire and other methods previously referred to (see Chap. 29, Alloy Steel Wire) have contributed much to the results obtained.

Umbilical Colostomy

Hirschman[41] has been an advocate of placing the colonic stoma at the umbilical site. It is his opinion that the central location is advantageous because of abdominal wall strength and more natural opening. The umbilicus is always excised so that the colostomy is drawn through this site.

Precolostomy

Where abdominal exploration has proved the case to be inoperable, the surgeon is and should be reluctant to divert the fecal stream and establish a colostomy where the bowel is not obstructed. There may arise occasions when one hesitates to subject the patient to another operative procedure at a later time, for which Stone[101] recommends what he terms a "precolostomy" procedure. Here, a small left McBurney incision is made and the sigmoid drawn through the wound until about one fourth of the circumference extends beyond the skin level. The loop is then loosely anchored to the skin with a few interrupted sutures. Thus is produced a small ventral hernia containing the attached loop of sigmoid, which may be instantly opened at any time without anesthesia.

Postoperative Treatment

The regime described under Preoperative and Postoperative Treatment of major lesions (Chap. 28), is instituted when nutritional, fluid and acid-base balance, the position of the patient in bed, movements of the limbs and use of suction are concerned.

When the bowel (colostomy) has been divided at the time of operation. Warm olive oil is instilled into the colostomy loop through the mushroom catheter held in place by the Daniel's clamp (see Malignancy, Chap. 19, p. 774). Thereafter, at four-hour intervals, from two to four ounces of warm saline solution alternating with 15 per cent hydrogen peroxide are used. Dressings are changed daily and the skin and incision cleansed with alcohol. Gauze saturated with tincture benzoin is placed on the incision, while a mineral oil dressing is loosely wrapped around the loop or loops. With the first fecal evacuation, usually within 48 hours, a soft diet is given. Irrigation of the lower loop (if one has been established) is begun, using potassium permanganate 1 to 8000, or, preferably, a suspension of sulfathalidine, from two to four times daily, depending upon the local pathologic process. A house diet is prescribed as soon as the condition of the patient permits, usually the fourth postoperative day.

Odor. Not infrequently colostomized persons complain of the odor, but this annoyance, too, can be removed if patient and physician co-operate. Measures of value to alleviate this condition are correct and frequent cleansing; irrigation of upper and lower bowel with warm potassium permanganate; washing and boiling the colostomy cup daily, and in some cases immersing it in a very dilute solution of sulphuric acid or ammonia and spraying the inner pad with an aromatic germicide. The use of methylene blue, grain i, and Kerol in capsule form containing 3 minims, is recommended before breakfast.[8, 35, 95] Freshly heated charcoal has been advocated for the purpose of absorbing gases in doses of from 15 to 30 grains thrice daily.[23, 38, 93] Carroll[11] employs a compound consisting of activated carbon, 90 per cent, with phenylsalicylate, 10 per cent in sealed enteric-coated capsules. It is prescribed thrice daily.

Belts. The wearing of a properly fitted belt will enable the patient to attend to his daily duties without embarrassment, provided he adheres to the essentials of diet and irrigation, and the colostomy is well constructed and properly located. To be efficient, the belt should be easily adjusted and cleaned, should not cause pressure on the anterior superior iliac spine, and should have a cup that fits snugly, thereby preventing herniation and prolapse. Cups of aluminum or celluloid and bags of rubber or canvas may be employed. A layer of cellulose, Cellophane, or oiled silk is helpful. The ball catheter devised by Dudley Smith[98] for irrigating the colostomy has proved of value. Other appliances have been suggested[44, 48, 50, 78, 107] together with the use of vaginal Tampax inserted into the stoma.[97] In our cases we ordinarily omit all types of bags and cups resorting only to clean dressings with a suitable belt or elastic binder.

Complications and Sequelae

Obstruction due to a portion of the small bowel passing between the colostomy and the parietal peritoneum is fortunately of infrequent occurrence. Several instances have been reported.[15, 29, 30, 32, 64] Such a complication may be avoided by inserting a purse-string suture between the sigmoid and the lateral peritoneum.[10, 33, 61, 80] In a suspected case of this type of obstruction, Gabriel[30] advises exploration through an oblique incision external to the colostomy. Prolapse of the omentum beside the colostomy loop is likewise a serious accident but, to a large measure, may be avoided by making the wound fit snugly so as to admit but one finger on each side of the protruding loop.

Retraction of the colostomy loop, while uncommon, may occur where the mesosigmoid is short or sufficient mobilization has not been effected. Excessive abdominal fat of the wall may be a factor also. This complication may be avoided by obtaining a viable colostomy stump one and one-half to two inches above the abdominal skin. Retraction seldom occurs during the first few days of the postoperative period, and after 48 hours the peritoneum becomes sealed off, so that there is usually little danger of discharge of contents into the peritoneal cavity provided the bowel loop or loops are viable. If such should take place, immediate isolation, fixation and drainage should be instituted. Innumerable instances of retraction have occurred in our experience in the ordinary type of colostomy, single or double-barrelled, and in the Mikulicz as well as the Rankin type of obstructive resection. In the presence of a viable loop, which is not difficult to determine, separation of the skin and fascial layers immediately adjacent and watchful waiting have served as a conservative approach to the problem.

Gangrene of the loop of bowel may occur, owing to faulty nutrition of the segment or to pressure resulting from too small an abdominal incision or too tight closure of the various layers. A procedure usually of advantage in this emergency is either to nick the constricting skin and fascia or, where the sutures are interrupted, to with-

Fig. 629. Method of incising bowel using glass rod as a guide.

thereby may acquire a sense of security. Therefore, to eat regularly and only three times a day, to limit the fluid allowance and to select food judiciously is a lesson that should be learned and practiced.

The *following foods may be taken:* broths containing barley, rice, chicken or mutton; farinaceous articles such as tapioca, cream of wheat, hominy, arrowroot, sago, toast, zwieback and rice; such meats as broiled steak, sweetbreads, boiled brains, raw scraped beef, broiled mutton or lamb chops, chicken and roast turkey; fish and raw or poached eggs; mashed or baked potatoes; boiled or peptonized milk, malted milk and bland desserts.

To control the number of stools in colostomized patients, Bargen and Victor[0] recommend the diet on page 861.

Where a normal habit has been established, the occurrence of a violent diarrhea, which is not altogether uncommon, is best treated by the administration of a dose of castor oil to cleanse the bowel of its retained solid particles. Should numerous liquid movements continue after the lapse of 24 hours, small doses of paregoric may be given, or kaomagma and kaopectate may be employed. Constipation, on the other hand, should be managed by means of irrigations.

Irritation of the skin surrounding the colostomy is often the cause of distress. In the author's cases, frequent cleansing and the direct application of the compound suggested by *McLanahan[93] have proved satisfactory.*

℞

Aluminum metal (fine powder)	1 part
Liquid petrolatum or olive oil	q.s. to stiff paste
Zinc oxide ointment	*2 parts*

Freeman advocates a modification of the DeBakey vinylite resin since, according to his opinion, it alone is not sufficiently adherent and insoluble.

Vinylite resin	25
Acetone	100
Collodion	25

The directions are as follows:

1. First application prior to opening enterostomy
2. First cleanse skin with ether and acetone —use no other medications
3. *Solution poured on skin and incision* and smeared evenly with an applicator or tongue depressor. Not harmful to bowel
4. Allow from 10 to 20 minutes for thorough drying
5. Open bowel and apply sterile dressing
6. *Apply additional* coats as needed without removing preceding coats

Other remedies are tincture benzoin and powdered zinc stearate.

For patient afflicted with diarrhea, Shedden[95] recommends the following:

℞

Tincture opium	20 cc.
Spirits camphor	20 cc.
Spirits peppermint	20 cc.
Tincture capsicum	10 cc.
Tincture rhubarb	10 cc.
Alcohol	20 cc.

Sig.: 10 M. which may be repeated in three hours

Holley suggests:

Aromatic sulphuric acid	āā ʒiv
Fld. ext. haemotoxylin	℥ii
Tr. opii camphoratum	f.℥ii
Syr. pruni virg.	āā ʒii
Aqua cinnamoni	q.s. Oi

Sig.: Tablespoonful every three hours.

PLATE 18



Extreme prolapse of colostomy following modified Mikulicz procedure for gangrenous sigmoid. The patient failed to return as instructed for repair of the colostomy. Instead of returning in six weeks she returned six years later with this unusual condition. (P. Thorek: Am. J. Surg. May, 1947.)



Fig. 630. Stoma of colostomy.

draw the stitch nearest the bowel. The great *danger of vascular necrosis is, of course,* lethal peritonitis, in which eventuality immediate laparotomy is indicated.

Stenosis or Contraction of the orifice is encountered occasionally. In our experience it is more common in the colored race, which, in part, may be explained on the basis of "fibroblastic diathesis,"[91] or negromata.[50] *Where a colostomy has been made* preparatory to excision of the rectum for inflammatory stricture, finger dilatation has proved of benefit in some cases. Some form of plastic operation is frequently required. *We have found the method suggested by* Martin[67] for anal stenosis (see p. 399, Chap. 12, Inflammatory Stricture) to be especially applicable here.

Technic. The skin is incised above and below the colostomy for a distance of one to one and one-half inches; the underlying fascia may necessitate nicking, which offers a vent at each end. The mucous membrane of the bowel is gently separated from the edge of the abdominal wall, stretched and tacked into each vent with two or more catgut sutures interruptedly placed.

Prolapse of the bowel is not uncommon. To a large measure it may be prevented by selecting the highest portion of the pelvic sigmoid just distal to the iliac sigmoid. Various methods *have been suggested for* its correction, among which may be mentioned injections of quinine and urea hydrochloride, 5 per cent solution, or phenol in oil 5 per cent. With these the author has had no experience. Amputation of the prolapse, which in reality represents an intussusception, has been advocated *in the* method of Mikulicz.[68] Here the prolapse is transected above the skin margin, leaving only sufficient cuff of outer layer to suture to the inner layer. Hall[39] applied the principle *of ligation over a semisolid* rubber tube placed in the colonic stoma just as Reid[55, 89] suggested in the treatment of procidentia *of the rectum.* (*See Prolapse,* Chap. 17, p. 536.)

One danger, of course, from such a procedure is peritonitis, and the possibility of a knuckle of small bowel being present *must also be considered.* Veal[102] *cites an* instance of peritonitis and recommends a two-stage maneuver not unlike that described by Mikulicz. Keeley[47] has summarized the subject well by advising that the procedure be adapted to the individual case. Our usual approach to the problem of prolapse is initially to employ a flat gauze *dressing and a tight abdominal* binder. At no time do we advise a bag other than for ileostomy. For severe cases, we are not in harmony with the amputative method of Mikulicz and its modifications. To us it *appears more rational, following a period of* preparation and nonabsorbable sulfonamide therapy, to wrap the prolapsed bowel in a towel and separate it from the abdominal wall. Intra-abdominally the bowel is drawn *taut through the wound, microcrystalline* sulfathiazole is sprinkled over the adjacent viscera (2½ Gm.), and the wound is closed in layers, using alloy steel wire. The prolapsed segment of bowel is then divided *by cautery between Payr* clamps. We have employed this method on several occasions and have found it highly satisfactory.

Phlebitis of the vessels of the mesosigmoid, *while infrequent,* has been known to occur. Abscess formation around the colostomy, cellulitis and *ulceration of* the surrounding skin fortunately respond to incision, drainage and meticulous care.

Closure of Colostomy

Under certain circumstances, closure of the colostomy is indicated. Closure incident

to the Mikulicz and Rankin type of resection has been discussed under Malignancy (see Chap. 19, p. 809), together with application of various clamps to spur and of fecal fistula under Fistula (see Chap. 7, p. 215). Among the causes for the difficulty in closing colostomies may be mentioned short, taut loop of bowel, insufficient mobilization, infection of the abdominal wall and wide separation of bowel loops with interposition of mesosigmoid, omentum and small intestine.

Closure may be effected by the intraperitoneal or extraperitoneal method, each of which presents certain advantages and disadvantages.

Preparation. The preliminary preparation of the patient in either type of closure is an important factor in accomplishing primary union. Ordinarily a low-residue diet is prescribed, as discussed under Preoperative and Postoperative Treatment of Major Procedures (Chap. 28). Until 1942, it was our custom to irrigate the upper and lower bowel segments each day with warm saline or potassium permanganate solution. Since that time a suspension of phthalylsulfathiazole or succinylsulfathiazole is administered according to the kilogram weight of the patient (see Chap. 28), ⅓ of the quantity being given by mouth, ⅓ used to irrigate the upper or proximal loop and ⅓ for the lower or distal loop. The drug is administered in suspension form every six hours around the clock (6 A.M., 12 M., 6 P.M. and 12 P.M.) for seven days prior to operation, although the patient is not necessarily confined to the hospital for that period. There is no doubt that the results achieved have been superior to those previously encountered. It is our opinion that nonabsorbable sulfonamide therapy is of utmost value, although other factors, such as correction of hypoproteinemia and avitaminosis, establishment of adequate drainage and especially meticulous surgical technic, are measures to be highly respected.

A recent report by Dixon and Benson[22] pertinent to closure of colonic stomas disclosed that, in a series of 102 cases, infection of the wound occurred in 13 per cent and a fecal fistula in 2 per cent in which a combination of succinylsulfathiazole orally and sulfathiazole intraperitoneally was administered, whereas infection occurred in 84 per cent and fecal fistula in 30 per cent where no sulfonamide drug was employed.



Fig. 631. Prolapse of the sigmoid.

It cannot be stated that we prefer one type of closure to the other, since each case is an individual problem. Ordinarily, the procedure is begun as one for the extraperitoneal method, but if it becomes apparent that closure cannot be effected satisfactorily and without tension, we do not hesitate to enter the abdomen. A review of our records shows that approximately 65 per cent of cases are closed by the intraperitoneal method.

Intraperitoneal Method of Closure. Undoubtedly this technic permits greater flexibility of mobilization, although the possibility of peritoneal contamination must be considered.

Technic. The skin surface and edges of the stoma are rendered as sterile as possible. By elevating the edges of the colostomy with Babcock visceral forceps and holding them taut with a rubber band, the skin edges are dissected free and the incision extended above and below the colostomy loop for a distance of approximately one

toneum, interrupted sutures of No. 32 alloy steel wire for fascia and No. 35 for skin. A small wick for drainage may be placed through the lower edge of the incision. in the fact that failure is more frequently encountered, necessitating repetition of the closure. Intestinal obstruction is somewhat more common, too. It is also our contention

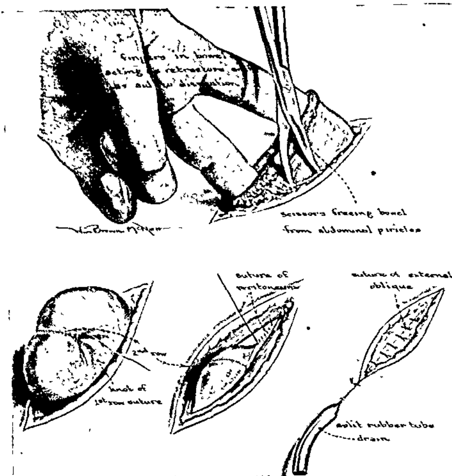


FIG. 633. Closure of colostomy. Elliptical incisions have been made around the stoma and extended through the stoma and extended through the fascia and muscle using the index and middle fingers of the left hand as tractors. Upon completion of the mobilization, the edges are trimmed clear of the margin of skin. (*Bottom, left*) The opening in the bowel is sutured transversely with two rows of chromic catgut. (*Bottom, center*) The bowel has been replaced in the abdominal cavity and closure of the peritoneum begun. The fascia is closed with interrupted sutures of catgut or steel alloy wire. (*Bottom, right*) A small drain is inserted in the lower edge of the wound down to the fascia as shown in right lower. (Redrawn from Rankin and Graham.)

Another method of intraperitoneal closure which we have used satisfactorily, especially where sulfonamide therapy is employed, is that described by Rankin and Graham[84] and illustrated in Figure 633.

Extraperitoneal Method of Closure. The chief disadvantage of this method lies that the risk of incisional hernia is greater since one is less apt to effect closure as accurately as with the preceding method. The technic here is similar to the intraperitoneal method, with the exception that the peritoneal cavity is not entered. In other words, the bowel is dissected free

inch. The skin edges are retracted and elevated with fine finger retractors and the dissection continued close to and around the bowel until the parietal peritoneum is sprinkled over the line of closure and immediate adjacent viscera.

Recently, penicillin, from 100,000 to 500,000 units, and streptomycin, 2 Gm.,

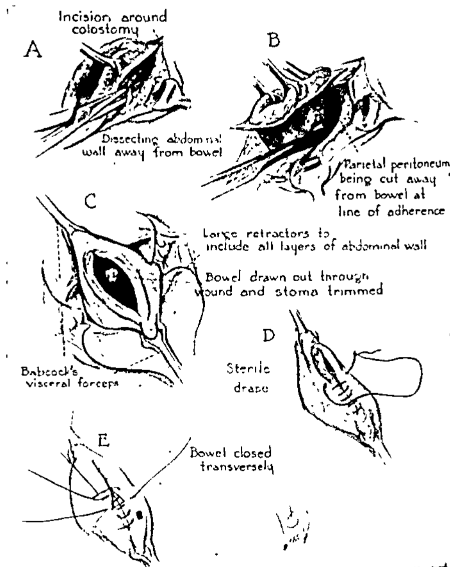


Fig. 632. Intraperitoneal closure of colostomy.

reached and nicked. Retractors of large size (Richardson) are now substituted and the bowel completely mobilized from the adherent peritoneum. The bowel is drawn through the wound protected by sterile drapes and its edges excised with straight scissors. A continuous suture of No. 00 chromic catgut is introduced and followed usually by a second layer interruptedly placed. The closed bowel is returned to the abdomen and sulfathiazole (2½ Gm.) is have been used instead. Usually the great omentum is employed in the coverage. Should gross contamination occur, a Babcock perforated sump drain of alloy steel is placed in the abdominal cavity and attached to the pump (see p. 216) upon return of the patient to his room. Finally, the abdominal cavity is closed using figure-of-8 sutures of No. 32 alloy steel wire through peritoneum and fascia (see Chap. 29), or a continuous suture of No. 0 chromic catgut for peri-

effected in its transverse axis by introducing a Connell stitch overlaid by a Lembert stitch. Circumferential rim of fascia is then sutured longitudinally. Tension sutures are introduced and the anterior rectus sheath approximated to allow for drainage. A Penrose drain is placed in the depth of the wound to protrude from each end of the incision. Finally, the tension sutures are tied (Fig. 634).

Methods of "delayed primary closure," previously discussed (see Fistula, Chap. 7), may be well selected in certain cases, as outlined by Coller[14] and Pemberton.[74]

Mortality Following Colostomy

The steady decline of the death rate from colostomy of all kinds has been noted from time to time in various statistical reports. In 1853, Hawkins reported that in the 44 cases performed up to that time the mortality had been approximately 50 per cent; in 1873, Mason recorded the performance of 80 additional cases with a mortality of only 30 per cent. Of 255 cases collected by Tuttle, there were eight deaths, or 3.1 per cent. Grey-Turner cited an incidence of 9.6 per cent. As would be expected, the mortality rate increases markedly in the presence of obstruction. In order to rationalize the operative mortality, colostomy cases have been analyzed into three distinct groups, as follows: (A) those in which colostomy is performed for acute colic obstruction; (B) those in which colostomy is established in the presence of advanced inoperable cancer; and (C) those in which a colostomy is made as a preliminary to radical excision.

(A) It is generally recognized that the mortality following colostomy for acute colic obstruction is extremely high. This is evidenced by the report of Miller,[67] who cites a death rate of 61 per cent, McIvers,[62] 44 per cent, Meyer and Spivack,[65] 48.6 per cent, Johnson,[46] 23 per cent, and Romano and Trachtenberg,[90] 45 per cent. Leigh, Nelson and Swenson[51] recently cited a mortality of 13.2 per cent in a group of 76 cases. In 68 of this number intubation was successfully instituted with a death rate of 5.9 per cent. As discussed under Preoperative and Postoperative Treatment, Major Procedures (Chap. 28), acute intestinal obstruction is not necessarily an emergency surgical procedure but it does require emergency treatment. It entails correction of the bodily derangements as well as decompressive measures. Acute complete colic obstruction does usually require an external decompression vent because of competency of the ileocecal valve. When the obstruction is of the strangulated type, an emergency surgical decompression is of course imperative.

(B) Probably the most extensive reports in this connection are those of Rankin,[81] who cited a mortality of 7.6 per cent in a series of 385 cases of inoperable cancer in which colostomy was performed for palliation. Gabriel,[31] in a group of 500 similar cases, computed his mortality at 13.4 per cent. Coller and Ransom[12] observed 25 deaths in 144 colostomies, an incidence of 17.4 per cent, while David and Gilchrist[17] report a mortality of 2.3 per cent in 89 cases. In many respects, little may be gained from such statistics. With the prevalent increase in resectability there is concomitant decrease in colostomy performance. In other words, an artificial abdominal stoma is being established less frequently and, by the same token, more often in bad risk patients. For this reason one may encounter a high rate of mortality, such as Babcock reports, namely, 30 per cent. Similarly, Rankin[79] observed a death rate of 15.3 per cent for decompression in nonresected cases, compared to 11.6 per cent for the resected group.

(C) As a preliminary step to radical excision, the mortality rate is usually low. Gabriel reports 2.5 per cent in 470 cases, Rankin 2.17 per cent in 584 cases, and Yeomans[100] no deaths in 86 cases.

Duration of Life Following Colostomy

In many instances establishment of a colostomy is a lifesaving measure, but in malignancy this prolongation of life is comparatively brief. A few exceptional cases in which the patient survived ten, fifteen or

from the skin, fascia and muscle down to, but not through, the peritoneal layer. The edges of the stoma are freshened with straight scissors and the bowel is united in its transverse axis in the usual manner using a continuous suture of No. 00 chromic catgut and a second serosal layer of similar catgut interruptedly placed. The bowel is then overlaid by the abdominal muscles, fascia and skin using interrupted sutures of No. 32 alloy steel wire for fascia and No. 35 for skin. A small wick of rubber tubing or dam is placed in the lower edge of the incision for drainage.

Shallow, Eger and Tourish[94] report primary healing in 81.3 per cent of 75 consecutive cases performed by an improved extraperitoneal method. The technic is described as follows:

An elliptical incision is carried longitudinally around the colostomy to the anterior rectus sheath, leaving a narrow rim attached to stoma for traction. The subcutaneous tissue is dissected from the rectus sheath and bowel wall leaving an inch margin around the colostomy. A circumferential incision is made through the rectus sheath leaving a one-quarter rim of fascia attached to bowel which will be subsequently used as an extra layer in the closure. Excess mucous membrane and rim of skin are excised. Closure of the bowel is

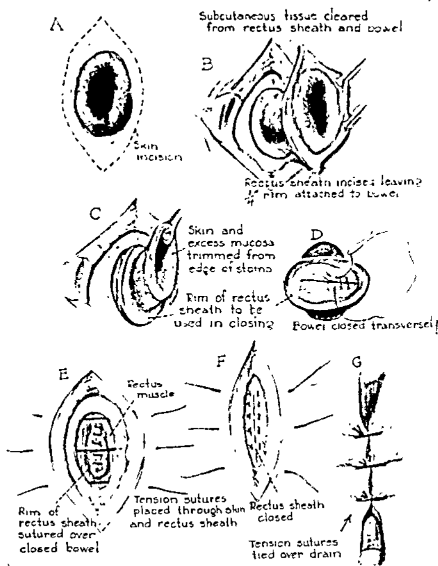


FIG. 634. Extraperitoneal technic. Redrawn from Shallow.

distant from the left lower abdomen, the latter is left free and clean for subsequent exploration and resection. Transversostomy achieves both decompression and defunctionalization, which is not true of either appendicostomy or cecostomy. There are many who prefer this type of external vent to complement primary resection of the left colon, sigmoid and upper rectum, but our choice in the past was appendicostomy, with transversostomy a second preference. The procedure carries with it a low mortality, as evidenced by the report of Fallis,[20] who, in a group of 62 cases, cites two deaths neither of which was due to the procedure itself. While no mortality has been noted, in a recent case evisceration of the large and small bowel with a portion of the stomach occurred, even though the rectus was not incised. My associate, Doctor Clifford E. Hardwick, replaced the viscera with but little difficulty a few hours after it was found. The patient made an uneventful recovery, and four weeks later an abdominoperineal proctosigmoidectomy was successfully performed for carcinoma of the rectum.

Technic. The abdomen is opened through a transverse modified Singleton incision[96] approximately one third the distance between the umbilicus and the xiphoid process. If a coin is placed over the navel when the x-ray exposure is made, the incision can be precisely made directly over the distended colon, as outlined by Wangensteen.[104] The anterior sheath of the right rectus is incised transversely and the rectus retracted laterally. In some instances it may be necessary to cut across its belly. The posterior sheath and peritoneum, which are firmly adherent, are split transversely and a knuckle of transverse colon brought through the retracted wound. By holding the bowel with the thumb and index finger, a nick is made with scissors in the fatty tissue beneath the thumb at the mesenteric border and the opening enlarged to admit the index finger. The transverse colon is held taut and the mesocolon incised to permit insertion of a glass rod, the ends of which are connected with a rubber tube. Thereafter, the peritoneum and posterior rectus sheath are approximated transversely on either side of the protruding bowel loops with No. 0 chromic catgut. Constriction of the limbs of bowel should be avoided. Under no circumstance are sutures ever placed between the bowel and any portion of the abdominal wall. The rectus muscle is permitted to assume its natural position if it has not been cut, otherwise it is approximated with interrupted sutures of the mattress type. Closure of the anterior sheath is accomplished by introducing sutures of alloy steel, No. 32 gauge, on either side of the bowel as needed. The skin is approximated with No. 35 alloy steel wire. A sterile dressing or one wrung out in tincture benzoin is placed over the wound. Ordinarily, petroleum jelly gauze or a mineral oil dressing is loosely wrapped about the protruding bowel for 48 hours, at which time it is opened by the cautery or surgical diathermy at a right angle to its long axis and deeply to the glass rod. In the presence of marked distention, however, the bowel is deflated by introducing a large-bore needle and withdrawing the plunger of the attached syringe or, as Wangensteen better suggests, attaching the needle to suction. A purse-string suture is introduced around the needle hole, which is enlarged to admit a rubber catheter which is tied in place. Recently, except in the presence of acute complete colic obstruction, we have divided the bowel immediately and introduced a mushroom catheter into each limb, both of which are held in place by a Daniel's clamp. Irrigation is instituted every three or four hours, as previously described.

As to closure, the same methods as outlined elsewhere in this chapter may be employed here. Ordinarily, two weeks elapse between resection and the time of closure.

Defunctionalizing Transversostomy. The popularity accorded utilization of the transverse colon is largely due to the pioneer

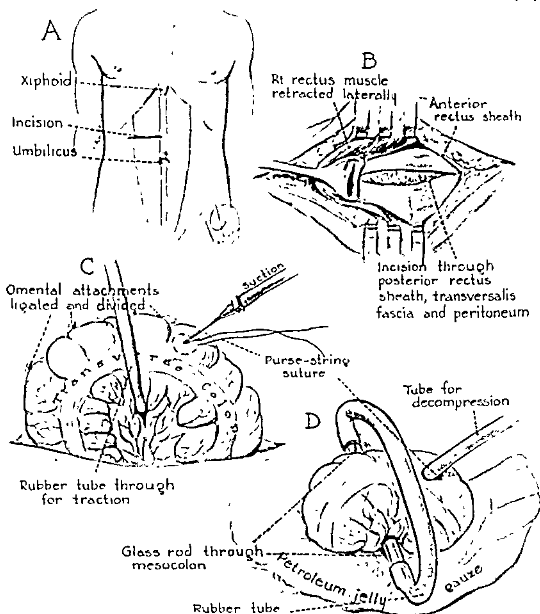


Fig. 635. Steps in performance of transversostomy.

even twenty years have been reported, but a study of these case records usually reveals that the diagnosis was a clinical one not supported by microscopy of tissue. Although patients colostomized for malignancy do survive for the five-year period, ordinarily the duration of life following colostomy in inoperable carcinoma is about six or seven months.

TRANSVERSOSTOMY

The establishment of an external decompressive vent in the transverse colon has been popularized during the past decade by Devine, Wangensteen and Fallis. It has been our choice for subacute and chronic obstructive processes of the distal bowel because it is simply executed and closure is not difficult to perform. Since the stoma is

feel, as do Heyd[39, 40] and Jackson,[43] that it is a fundamental contribution to large bowel surgery. It must be admitted that the Devine type of transversostomy provides both decompression and defunctionalization, the latter being better achieved than with the method just described. One recalls to mind the advantages of defunctionalization originally outlined by Devine, namely, that in a prepared, dysfunctioned and debacterialized distal colon, the fecal content is absent, the infectivity is greatly reduced, the bowel is collapsed, its wall thicker and its circulation improved (Figs. 637, 638).

Technic. A vertical incision two and one-half inches in length is made through the

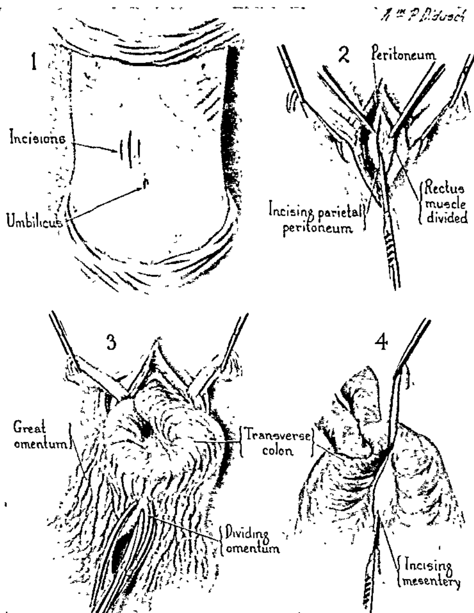


Fig. 637. Devine transversostomy. (1) Relative position of the incisions. (2) Undermining skin with gauze retraction. (3) Dividing the great omentum to permit evisceration of the colon. (4) Tape introduced through open space to produce double-barrelled colon. (C. G. Heyd: Ann. Surg. 116:914.)

work of Devine.[10, 20, 21] It is a practical procedure in selected cases. It has made safe primary resection in the aged and poor risk patients for inflammatory and malignant processes and as an initial step to resection for sigmoidovesical fistula. Where complete fecal diversion is required, such as resection for sigmoidovesical fistula, a preliminary transversostomy of this type has been found adequate. It is a method simply performed, but the subsequent closure is time consuming and not infrequently difficult. Perhaps the author should be more hesitant in making such a statement, since over the years we have employed it in no more than twenty instances. There are those, however, who

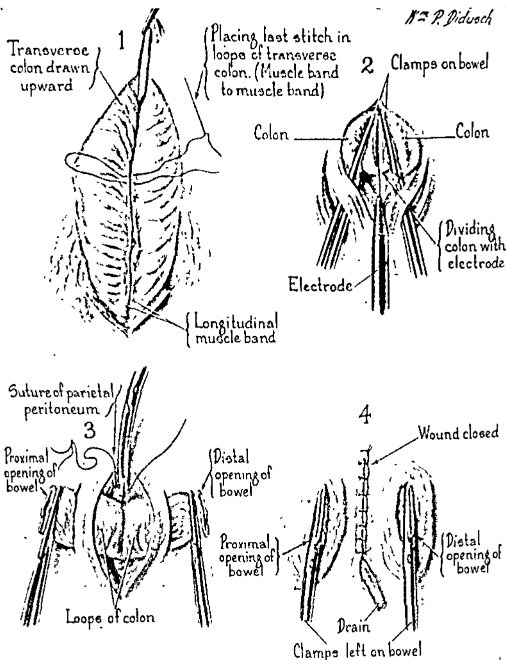


FIG. 636. Devine transversostomy. (1) Approximation of white bands by sutures. (2) Bowel segments clamped and colon divided by cautery. (3) Exit of the proximal and distal loops. (4) Final appearance of wounds of a Devine colostomy. (C. G. Heyd: Ann. Surg. 116:915.)

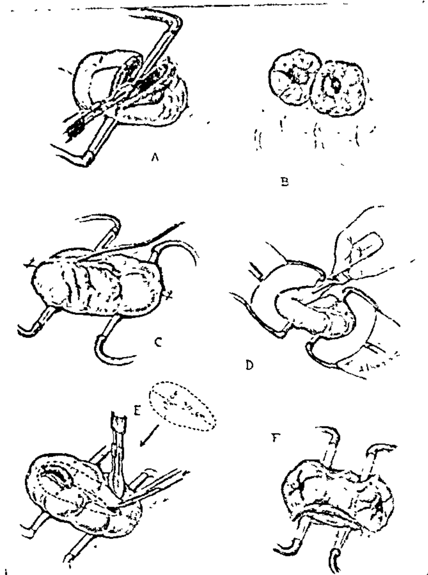


Fig. 642. Achieving complete fecal diversion with a loop colostomy (A to F—steps employed in making the loop colostomy). (A) The conventional way of dividing the exteriorized loop transversely to achieve fecal diversion. (B) The result after complete division; the lumens of the proximal and distal loops are separated only by the thickness of the walls of the two opposed loops. (C) The technic described herein employing two glass rods and exteriorizing a somewhat more generous segment. A slit has already been made in the gut wall, proximal to the first glass rod. In the presence of acute obstruction and distention, a needle aspiration at this same site is performed on completion of operation and again in 6 hours, at which time a slit is made in the bowel wall with cautery (usually) or knife to permit the introduction of a catheter, as is shown here. In the absence of obstruction, the exteriorized gut ordinarily is not opened until about 72 hours after operation, allowing the wound to become sealed more effectively. (D) The adhesive fastening to the rubber tube engaged over the ends of the glass rods is shown. This maneuver insured adherence of the exteriorized loop throughout the length of the incision. (E) Unroofing the proximal orifice by an elliptical incision; more of the roof overlying the proximal orifice is removed than the distal. (F) Following excision of a portion of the anterior wall of the exteriorized segment, the mucosa everts and becomes adherent to the skin. (Wangensteen, O. H.: Surg. Gynec. & Obst. 84:409.)

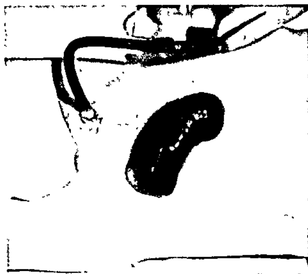


FIG. 638. B. C., age 9. Illustrations showing prolapse of the transverse colon.



FIG. 641. Devine colostomy.

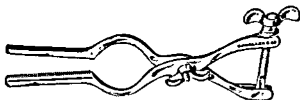


FIG. 639. Devine enterotome.

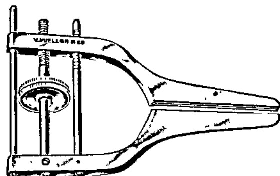


FIG. 640. Ochsner-DeBakey clamp.

abdominal skin over the upper portion of the right rectus muscle. Approximately one inch to each side of the primary incision, two parallel incisions are made from one to one and one-half inches in length. Both are freed from the underlying fascia. The abdomen is entered through the primary incision and the transverse colon gently withdrawn with Babcock visceral forceps. A rubber tube is passed through the mesocolon at the angle of the two limbs, which are stitched together using fine chromic catgut in an interrupted fashion. The bowel is partially replaced within the abdomen and the parietal peritoneum approximated with one or two sutures above and below as needed. Through each lateral incision, which has been carried down to, but not through, the muscle, a Kocher clamp is passed to grasp each side of bowel from the mesenteric to its omental edge. The bowel is divided between these two clamps with a diathermy knife or cautery. Each stump is withdrawn through its respective opening and the primary wound closed in layers without drainage. The proximal clamp remains in place for 12 hours and the distal one until it sloughs off, which is usually from five to seven days. This new stoma may be kept closed for 24 hours, if desired, by inserting and then inflating a small balloon or a No. 14 occluded catheter.

The required care consists of removing the tube or balloon once in 24 hours, emptying the colon, washing and replacement. The distal bowel is irrigated daily thereafter. In the presence of fecal or barium concretions, mineral or olive oil is injected, otherwise sulfathalidine in suspension form is instilled into the lower loop of bowel every six hours. At times washing through the rectum is required. Finally, when closure is desired, a long narrow enterotome is used by inserting one blade deeply into each opening and tightly closing it.

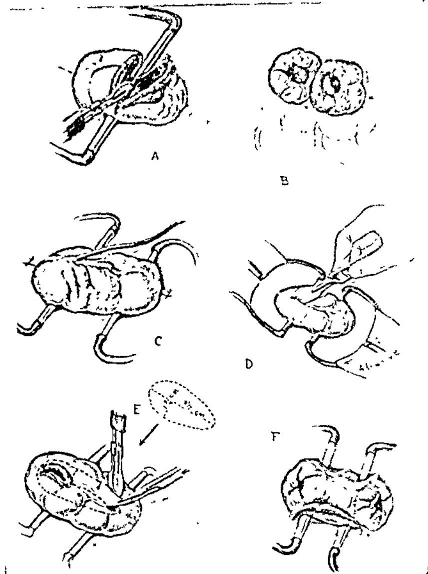


Fig. 642. Achieving complete fecal diversion with a loop colostomy (A to F—steps employed in making the loop colostomy). (A) The conventional way of dividing the exteriorized loop transversely to achieve fecal diversion. (B) The result after complete division; the lumens of the proximal and distal loops are separated only by the thickness of the walls of the two opposed loops. (C) The technic described herein employing two glass rods and exteriorizing a somewhat more generous segment. A slit has already been made in the gut wall, proximal to the first glass rod. In the presence of acute obstruction and distention, a needle aspiration at this same site is performed on completion of operation and again in 6 hours, at which time a slit is made in the bowel wall with cautery (usually) or knife to permit the introduction of a catheter, as is shown here. In the absence of obstruction, the exteriorized gut ordinarily is not opened until about 72 hours after operation, allowing the wound to become sealed more effectively. (D) The adhesive fastening to the rubber tube engaged over the ends of the glass rods is shown. This maneuver insured adherence of the exteriorized loop throughout the length of the incision. (E) Unroofing the proximal orifice by an elliptical incision; more of the roof overlying the proximal orifice is removed than the distal. (F) Following excision of a portion of the anterior wall of the exteriorized segment, the mucosa everts and becomes adherent to the skin. (Wangensteen, O. H.: Surg. Gynec. & Obst. 84:409.)

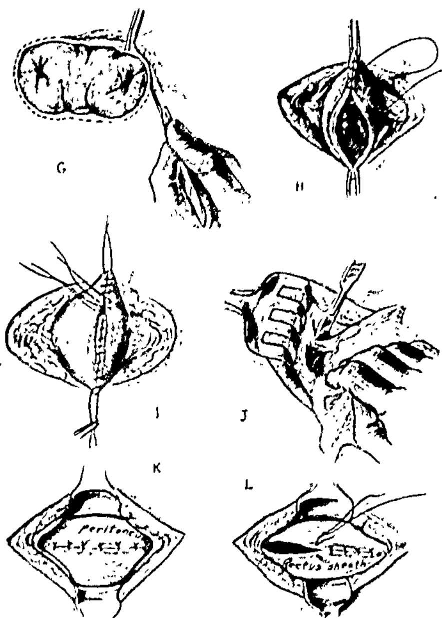


Fig. 642. (G to L—steps employed in closing the colostomy.) (G) It is obvious that the separation of the proximal and distal orifices of the exteriorized segment is far better than that achieved by the conventional method of dealing with the loop colostomy. An incision is *made in the skin from 2 to 3 millimeters from the mucosal edge. (H)* A running suture of fine catgut is employed to close the opened bowel transversely. (I) The wound's edges are painted with a local antiseptic, and the wound is redraped. After the gut is freed up adequately, a single row of interrupted fine silk sutures (No. 0000) is placed to invert the initial closure with catgut. (J)) The bowel is dissected completely free from the parietal peritoneum, permitting return of the bowel to the peritoneal cavity. This same procedure gives assurance that the peritoneum and the posterior rectus sheath can be sutured satisfactorily. (K) Suture of the posterior rectus sheath and peritoneum with interrupted sutures of silk (No. 000). (L) Closure of the anterior rectus sheath (silk No. 000). After closure of the peritoneum (K), the wound is washed out with liberal quantities of saline solution and again after closure of the anterior rectus sheath (L). (Wangensteen, O. H.: Surg., Gynec. & Obst. 84:409.)

To avoid difficulty in adjusting the enterotome to the widely separated spur when re-establishment of bowel continuity is desired, Rosser prefers a transverse incision with placement of each bowel limb at opposite ends. Payr or Stone clamps are applied and the bowel divided and the skin closed between the bowel segments. When continuity is desired, the intervening skin is incised to allow apposition of the loops, which facilitates introduction of the enterotome.

A simple innovation published recently by Wangensteen[101] permits complete diversion by maintaining fixation of each exteriorized loop. The technic is shown in Figure 642.

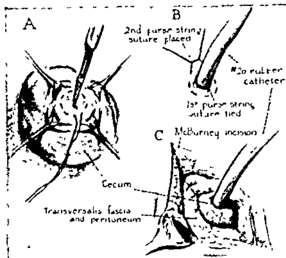


FIG. 643. Cecostomy.

CECOSTOMY (TYPHLOSTOMY)

There are numerous methods of establishing an artificial stoma in the cecum, and in this respect such names as Kader, Witzel, Stamm, Ssabanajew-Frank and Gibson are prominent from yesteryear. More recently, contributions to this subject have been added by Allen,[1] McNealy,[64] Whipple,[105] and others.[16, 37, 42, 69, 71, 83] Ordinarily, a rubber tube is carried through an opening in the cecum, or the bowel is anchored to the abdominal wall.

Cecostomy may be performed as an emergency procedure for complete colic obstruction, but its field of usefulness, for the most part, should be confined to decompression of obstructive lesions involving the ascending, hepatic and transverse colon. In the same manner as appendicostomy, it may be employed as a preliminary or complemental maneuver to primary resection. While decompression can be obtained by cecostomy, defunctionalization of the distal segment cannot be achieved. To offset this disadvantage, Millet[68] and Berman[7] advise the passage of an intubation tube through the cecostomy for the purpose of "backflushing," a procedure which we have employed in only one instance. The uncertainties and hazards of cecostomy, however, must be appreciated in spite of the various technics and modifications suggested. It is conceded that typhlostomy for complete colic obstruction carries with it a high mortality ranging from 50 to 71 per cent, as reported.[12, 104]

Technic. A small muscle-splitting incision of the McBurney type is made in the right lower quadrant of the abdomen and the cecum delivered through the wound. A purse-string suture is placed in the seromuscular wall of the bowel and left untied. It should be of sufficient size to admit a No. 26 rubber catheter. Some[21] prefer to introduce a trocar with a pointed obturator, which, when the latter is withdrawn, permits removal of the bowel contents by suction. Thereafter the trocar is replaced by a rubber tube. Others[1] prefer a right-angled glass tube with double flanges of the Paul type. Whatever type of tubing is employed, the purse-string suture is tied and a second similar suture introduced in order to provide ample invagination. The cone of the cecum containing the catheter is brought up into the wound and tacked with two or three fine sutures to the parietal peritoneum. The fascia around the cecal cone is approximated in layers using No. 32 alloy steel wire sutures interruptedly placed; No. 35 for skin.

Postoperative Care. The catheter is connected to a bottle beside the bed to collect the fecal contents. Ordinarily it is our custom to instill and aspirate a few ounces of

warm saline, a 15 per cent hydrogen peroxide solution or alternate with a suspension of sulfathalidine every three or four hours. Of course, a certain proportion will close spontaneously, although it has been our experience that well over 50 per cent require closure by methods previously outlined.

APPENDICOSTOMY

This procedure provides a route from the interior of the cecum to the skin surface by way of the lumen of the appendix. The employment of an appendicostomy has ceased to be a moot question, since it is more or less universally condemned. There are definite disadvantages, such as inability to obtain defunctionalization, or the appendix may be obliterated, short, retrocecal or absent, from previous removal. Independent of the criticism accorded, we utilize the appendix, when available, to complement primary resection but never for acute complete colic obstruction except in the occasional instance of a very sick patient in which the procedure may be performed under local analgesia. Ordinarily appendicostomy is easily and quickly done, soiling

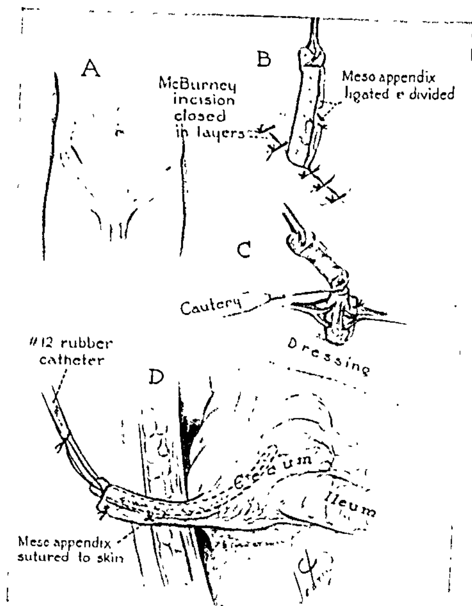


Fig. 644. Appendicostomy.

is minimal and closure usually spontaneous. According to Rankin, it carries with it the smallest mortality of all such procedures.

Technic. The abdomen is opened in the usual manner through a right McBurney muscle-splitting incision. The appendix is located, freed of adhesions and delivered through the wound; the meso-appendix being clamped, divided and ligated at a level which will insure adequate blood supply to the extruded portion. An anchor suture may be passed joining the meso-appendix to the parietal peritoneum to prevent retraction. The tip of the appendix is held vertically with Babcock visceral forceps and the peritoneum, fascia and skin closed around the extended organ. Care must be taken to make a snug closure and at the same time avoid constricting the appendix. Split dressings are applied, after which visceral forceps are lightly placed immediately below the site where the appendix is to be cut across. Following transsection of the appendix tip, a well lubricated No. 12 or 14 French rubber catheter is gently introduced through the appendiceal stump into the lumen of the cecum. Immediately a few ounces of warm saline solution are instilled and the catheter carefully manipulated until aspiration of contents is adequate. One wire suture (No. 36) is placed between the skin and an avascular area in the meso-appendix and the catheter. The catheter is connected to a bottle beside the bed, and instillations with aspiration are continued every three or four hours using the solutions previously mentioned. To complement primary resection, the catheter is removed after the first bowel movement. The appendix usually closes spontaneously thereafter. Occasionally it may be necessary to cauterize the edges. Should closure not take place after a few weeks, the method previously outlined may be employed.

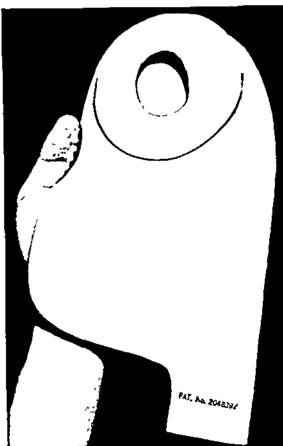


Fig. 645. Rutzen ileostomy bag.

ILEOSTOMY

This is a procedure which we seldom employ other than as a preliminary step to total colectomy, especially for ulcerative colitis and polyposis. The technic differs but little from that previously described. Much has been written on the subject of care of the skin which, for the most part, has been unsatisfactory both as to medicaments and various contraptions. In a measure this has been discussed elsewhere. The Rutzen bag has proved highly satisfactory. Acetyltannate and albumin tannate therapy, as suggested by Peelen,[73] appears to have merit.

Based on the work of Nissen, an interesting article by Ravitch[86] appeared recently in which anal ileostomy without colostomy and with preservation of the sphincters was successfully effected. This procedure has been discussed thoroughly under Chronic Ulcerative Colitis, for which the reader is referred to Chapter 9.

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CHAPTER 21

Transplantation of Transverse Colon to Anus: Resection Without Colostomy and with Preservation of Sphincter Musculature (One-Stage Procedure)

Many years of life have been afforded innumerable persons because they have accepted a form of surgical therapy of which the establishment of a permanent abdominal colostomy was an integral part. In the average case where *the surgeon has fashioned* a technically correct colostomy and has educated the patient in the proper care of it, an abdominal colostomy has been compatible with a relatively normal life.

No one, however, desires an abdominal colostomy. If a surgical procedure which does not embody a colostomy can be substituted, at a comparable chance of cure, risk and functional result, for an operation which necessitates one, it would seem reasonable to accept the surgical maneuver not requiring a colostomy.

During the past few years, the author has had occasion to employ a somewhat formidable procedure which, while definitely limited in its applicability, has served in some instances to avoid a colostomy and in others to eliminate an unsatisfactory one. While this method is not recommended for routine use, it appears, under the circumstances to be mentioned, to have been the procedure of choice. Essentially the procedure consists of a left hemicolectomy and proctosigmoidectomy with transplantation *of the distal transverse colon or splenic* flexure to the anus. It is performed in one stage and avoids an abdominal colostomy; the sphincter musculature is preserved. The author has performed this procedure on eleven patients, seven of whom have been reported by Smith and the writer.[5] The method is described briefly as follows:

Through a long left rectus incision, the distal portion of the transverse colon, the splenic flexure, descending colon, sigmoid and rectum are mobilized in the customary manner. Particular attention is given to preservation of the arterial arcades anastomosing with the middle colic artery. The arterial pattern has been discussed at length elsewhere.[3,4] For this maneuver, transillumination is of utmost value. Following closure of the abdomen, the perineal portion of the operation *is performed in an identical fashion to that in* proctosigmoidectomy, preserving the sphincter musculature (see p. 735, Chap. 19, Malig-

TABLE 86. TRANSPLANTATION OF TRANSVERSE COLON TO ANUS

NAME	RACE	SEX	AGE	DIAGNOSIS	DEATHS
1. C. B.	W	M	32	Polyposis with malignancy	0
2. E. A.	W	F	42	Polyposis with malignancy	0
3. W. J.	W	M	35	Adenocarcinoma (Hartmann operation)	0
4. G. R.	W	M	63	Extensive diverticulitis with stricture formation	0
5. S M.	W	M	28	Carcinoma	0
6 B. S.	C	F	46	Extensive inflammatory stricture of rectum and colon	0
7. M. L.	W	F	32	Ulcerative colitis and malignancy	0
8. M. B.	C	F	57	Malignancy	0
9. M. K.	W	M	62	Malignancy	0
10. R. S.	C	F	38	Inflammatory stricture extending from low rectum to splenic flexure	0
11. J. K.	W	M	65	Polyposis with malignancy	0

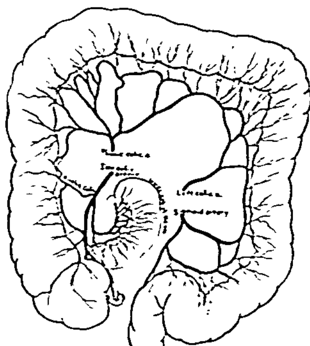


FIG. 646. In this procedure the left branch of the middle colic is preserved with its main communicating branches. (Bacon and Smith: Ann. Surg. 127:28.)

nancy). The mobilized bowel is withdrawn through the perineal wound until the distal transverse colon is brought into view. An anterolateral pelvic floor is established and the protruding rectum, sigmoid, descending colon and splenic flexure amputated distal to the anal verge.

The patients on whom this procedure was employed are summarized in Table 86 on the preceding page.

Case No. 1. C. B., a married male, age 32, cited a history of bleeding at the time of stool for a period of four years. Other than slight frequency, the bowel habit was regular. Past and family history were irrelevant. The patient had consulted several physicians, one of whom had fulgurated 22 polypoid growths in the rectum during the past year. Repeated opaque enema studies were reported as negative. Quite recently, because of continued bleeding, re-examination was done which disclosed a number of growths in the rectum and sigmoid. The histopathologic report was "adenomatous polyp with active proliferation." Resection was advocated, but was refused because of the proposed abdominal colostomy. Our first examination on September 16, 1946, showed approximately two dozen tumors in the rectum and sigmoid, on the basis of which an abdominoperineal proctosigmoidectomy with preservation of the sphincter muscles was advised. The patient was hospitalized and prepared in the customary manner. At operation October 3, 1946, a growth the size of a small cherry was palpable at the junction of the descending colon and sigmoid, and a suspicious process of similar dimensions in the splenic flexure. (X-ray examination prior to and following admission gave no evidence of polypi.) A left hemicolectomy and proctosigmoidectomy were performed with transplantation of the mobilized distal transverse colon to the anus. The bowel specimen, 68 cm. in length, was reported "multiple papillomatosis with malignant invasion in the body of the polyp but no invasion of the stalk." The patient was permitted out of bed on his sixth postoperative day and discharged, walking, on the fourteenth. Sphincter control was excellent.

Case No. 2. E. A., a married woman, age 42 years, had for the past seven years passed bright red blood with her stools. Five years ago she consulted a physician who removed several polyps from her rectum and informed her that they were benign. Her rectal bleeding continued, and one year ago her physician advised her to have a resection of her rectum with a permanent colostomy; this she summarily refused. She consulted a second physician who acquainted her with the malignant nature of the disease and advised her to have an abdominoperineal proctosigmoidectomy without colostomy and with preservation of the sphincter mechanism. The patient's grandfather, uncle, mother and sister had died of carcinoma of the rectum. On proctosigmoidoscopic examination, the rectum and lower sigmoid were found to be studded with small adenomas. A barium enema with air insufflation disclosed polyps in the upper sigmoid and descending colon. At operation, her rectum, sigmoid, descending colon and splenic flexure were excised. The stump of the transverse colon was transplanted to her anus. The sphincter mechanism was preserved. The pathologist reported an ulcerating adenocarcinoma, Grade II (Broder's classification), in the rectum, polyps in the sigmoid and a malignant adenoma in the descending colon. The many adenomas in the rectum were benign. The patient's convalescence was uneventful. She was discharged from the hospital, walking, on her thirteenth postoperative day. Sphincter control was excellent. Patient well with no evidence of recurrence, August, 1948.

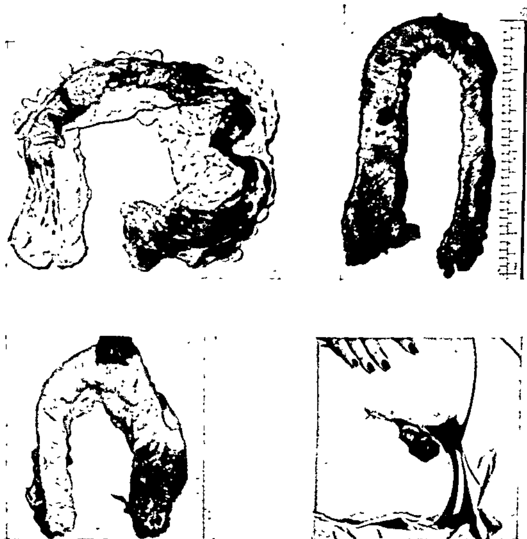
Case No. 3. W. J., a 35-year-old male, had passed bright red blood with his stools for the

PLATE 19





(*Left*) W. J. Resection of the rectum and left colon with transplantation of the transverse colon to the anus. (*Right*) B. S., age 46. Extensive inflammatory stricture of the rectum and the colon. Patient treated by left hemicolectomy and proctosigmoidectomy without colostomy. Transverse colon transplanted to anal orifice.



(*Top, left*) M. B., age 57. Resection of the rectum, sigmoid and descending colon and splenic flexure, with transplantation of the transverse colon to the anus. (*Top, right*) C. B., age 32. Myriads of adenomata and polypi throughout rectum, sigmoid and descending colon not clearly visualized. Polypoid growth reported as adenocarcinoma. Proctosigmoidectomy and left hemicolectomy; (*Bottom, left*) M. K., male, age 55. Adenocarcinoma of sigmoid, Grade II, with multiple adenomas of the bowel and additional carcinoma. Left hemicolectomy and proctosigmoidectomy with transplantation of the distal transverse colon to the anus with preservation of the sphincter musculature; (*Bottom, right*) M. B., age 32. Left hemicolectomy and proctosigmoidectomy without colostomy and with preservation of the sphincture musculature. Sixth postoperative day shows viable transverse colon protruding from the anal aperture prior to removal. (Sphincter muscles preserved in all.)

previous six weeks. A barium enema had been done two years ago, and no abnormal findings were noted. Because of a recent protrusion from his rectum and a continuation of his bleeding, he again sought medical aid. He had lost three pounds in the past month. On sigmoidoscopic examination a polypoid mass about the size of a cherry was seen 20 centimeters above the anus. At operation a sigmoidotomy was performed, and three papillary adenomas were removed from the sigmoid and descending colon. Two of them were described by the pathologist as malignant adenomas. A rather extensive incision was made into the sigmoid in an effort to discover further polyps. Due to technical difficulties there was more soiling than such a procedure usually entails, and it was thought expedient to complete the operation as a Hartmann type resection. Accordingly the upper rectum, rectosigmoid, sigmoid and a portion of the descending colon were excised and the end of the descending colon was brought out as a single-barrelled colostomy.The closed rectal stump was buried beneath the peritoneum of the pelvic floor. The patient's convalescence was without complication. Several months later despite efforts to dissuade him, the patient insisted on having his colostomy closed and the continuity of his bowel restored. At operation his colostomy was dissected free and closed. The remainder of the descending colon, the splenic flexure and the transverse colon were mobilized. The rectal stump was dissected free to the tip of the coccyx; because of its short length, an anastomosis with the descending colon was felt inexpedient. In the perineal phase the skin of the anal canal and the external sphincter muscle were preserved. The small rectal stump, the remainder of the descending colon, the splenic flexure and a portion of the transverse colon were excised and the transverse colon transplanted to the anus. Postoperatively the patient was febrile for 12 days. He was discharged from the hospital, walking, on his 18th day after operation. This patient has been pleased with his bowel function.

Case 4. G. R., a 63-year-old male, was seen after he had had abdominal cramps, fever and moderate constipation for two weeks. He had been treated conservatively in his local hospital and had recovered to the extent that he was ambulatory. On physical examination there was tenderness and a suggestion of a mass in his left lower abdomen. A barium enema revealed diverticulitis of the sigmoid and lower descending colon. Operation disclosed a markedly thickened and indurated sigmoid and lower descending colon which were covered with a mucinous exudate. The rectosigmoid, the sigmoid and a portion of the descending colon were excised. The closed rectal stump was buried beneath the peritoneum of the pelvic floor. The end of the descending colon was brought out as a single-barreled colostomy. The pathologist found a markedly thickened colon which contained multiple diverticuli and intramural abscesses. The lumen was markedly narrowed.

This patient was unable to perform his duties as a glass blower because of his colostomy. He insisted on having it closed and the continuity of his intestinal tract restored. His second operation, an abdominoperineal procedure exactly like that used in Case No. 3, consisted of the excision of his rectal stump, the remainder of his descending colon, splenic flexure and a portion of his transverse colon. The operation was completed at the same stage by transplanting the transverse colon to his anus with preservation of the sphincter mechanism. After an uncomplicated convalescence the patient was discharged from the hospital, walking, on his 14th postoperative day. Two months after his second operation he returned to work as a glass blower. Sphincter control has been excellent.

Case 5. S. M., a white male, age 28, was flown from Pearl Harbor in 1944 to McGuire General Hospital with the diagnosis of adenocarcinoma, Grade II, of the rectum. Dr. F. P. Coleman had performed an abdominoperineal excision of the Miles type.

When the patient consulted the author one year later, it was evident that an excellent result had been obtained. The abdominal colostomy was well established and functioned in a satisfactory fashion with daily irrigations. The perineal wound was nicely healed, and there was no evidence of recurrence. The patient stated that he was compelled to break his engagement to marry because of the colostomy; he had no desire to live and had even threatened suicide on several occasions. He wished to have the colostomy reconstructed. That this was impossible was explained to him, especially since the sphincter muscles had been removed. This and other attempts to dissuade him resolved itself into quite a problem and for several months he insisted that another operation be performed. The formidability was described in detail and especially the fact that he would be no better and perhaps worse than at present. Finally, the patient was admitted to Temple University

Hospital (May, 1946), and after several days preparation the colonic stoma was closed and the descending colon, splenic flexure and transverse colon mobilized, preserving the arcades to the middle colic artery. The peritoneal floor was opened and the closed stoma tucked in the pelvis. After closure of the abdomen, the bowel was drawn through a midline incision through the perineal scar. The descending colon and splenic flexure were then amputated distal to the margin. The patient was out of bed the sixth postoperative day; the redundant bowel removed the eighth postoperative day; he was discharged on the eleventh postoperative day and, according to his own story, celebrated his apparent ecstasy the following night by indulging in an act of cohabitation with a member of the opposite sex.

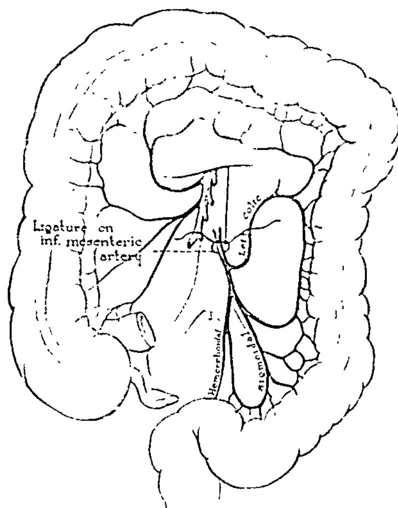


Fig. 647. Point of ligation for transplantation of transverse colon to perineum. The left branch of the middle colic is preserved; the left colic is sacrificed.

This patient made a very remarkable recovery; he returned to work carrying heavy sides of beef without incontinence; he learned to irrigate the bowel every second day; he does not soil nor does he wear pads. It may be mentioned that, following operation, the patient told the writer that he normally indulged in sexual intercourse almost every night for two, three and even six erections. After the Miles excision, no apparent effect was experienced, but on several occasions an untimely fecal evacuation from the colostomy soiled the lady of his choice, with resultant embarrassment.

It should be mentioned that the author's associates and himself have questioned this patient and several other patients in whom the abdominal colostomy was removed to



Fig. 648 A. Case 10: R. S., age 38. Roentgenogram showing inflammatory stricture extending from splenic flexure to low rectum. Hemicolectomy and proctosigmoidectomy was performed.



Fig. 648 B. Case 7: M. L., age 32. Opaque enema demonstrating absence of haustral markings from transverse colon to rectal ampulla. A malignant lesion in the lower rectum is not shown.

the perineum, asking which procedure they preferred. It may be stated truthfully that each has shown definite favor for the perineal anus. The writer wishes to go on record that a perineal colostomy (sphincter muscles sacrificed) is not recommended and should not be confused with the perineal anus, where the sphincter muscles are preserved as well as the anal epithelium.

One must admit, however, that those having had an abdominal colostomy and who have been given a perineal colostomy are certainly in a position to evaluate the advantages and disadvantages of each. That they are more pleased with the perineal colostomy has also been the experience of Babcock.[1, 2]

Case 6. B. S., a colored female, age 46, presented a lymphogranulomatous stricture of the rectum and sigmoid. Extensive ulceration existed above the stricture and a rectovaginal fistula below. Left hemicolectomy and proctosigmoidectomy was performed with excision of the posterior vaginal wall. A plastic procedure was instituted later, and for three months her condition was satisfactory. She moved to her home in the South at that time and has not been heard from since.

Case 7. M. L., female, age 32, presented a chronic ulcerative proctocolitis involving the rectum, sigmoid and descending colon and an adenocarcinoma, Grade II, of the rectum. She, too, made an uneventful recovery. Excellent muscle control exists.

Case 8. M. B., a colored female, age 57. Examination disclosed an adenocarcinoma of the rectosigmoid, Grade II. At the time of resection, extensive adhesions resulting from a previous peritonitis caused considerable concern with mobility, during the course of which the inferior mesenteric artery was inadvertently severed close to its origin. In this case also a left hemicolectomy and proctosigmoidectomy was performed without colostomy and with preservation of the sphincter musculature.

Case 9. M. K., a white male, age 62, adenocarcinoma of rectum Grade II with adenomatous polypi; additional carcinoma of the sigmoid. Left hemicolectomy and proctosigmoidectomy without colostomy and with pres-



Fig. 649. Case 1: C. B., age 32. Adenocarcinoma, Grade IIC, with multiple adenomatous polyps. Appearance of protruding stoma of the transverse colon following left hemicolectomy and abdominoperineal proctosigmoidectomy with transplantation of the transverse colon to the anus as a one-stage procedure. This protruding stump was excised and the anal skin sutured to replace the anorectal junction.

ervation of the sphincter musculature. Patient out of bed the fifth postoperative day but, because of deep calf-vein tenderness and unexplained concomitant rise in temperature and pulse, he was returned to bed and heparin-dicoumarol therapy begun. Outcome uneventful.

Case 10. R. S., a colored female, age 38, presented on examination an inflammatory stricture extending from the low rectum to a point immediately below the splenic flexure. A left hemicolectomy and proctosigmoidectomy was performed and the distal transverse colon transplanted to the anus. Patient out of bed sixth postoperative day, discharged on the eleventh and returned to work in two weeks.

Case 11. J. K., a white male, age 65. Examination disclosed an adenocarcinoma, Grade II, of the midrectum and an adenomatous polyp in the low sigmoid. Double-contrast enema study showed two processes in the proximal sigmoid and a third in the descending colon. At exploration, the bowel was incised and the presence of the proximal lesions confirmed by endoscopy, using the sigmoidoscope through the incised bowel. The gut was closed, after which the transverse colon, splenic flexure, descending colon, sigmoid and rectum were mobilized. Care was taken to preserve the middle colic artery. Having divided the gastrocolic omentum, sulfanilamide powder was sprinkled over the viscera and a Babcock sump drain placed in the left gutter. The abdomen was closed, and by the perineal route the sphincters were preserved and the entire mobilized bowel pulled through. A Daniel's clamp was applied to the bowel 7 cm. beyond the anal margin (see proctosigmoidectomy) and the distal portion cut away. Inspection disclosed six adenomatous polyps beside the carcinoma in the rectum. This patient was permitted out of bed on the third postoperative day. He suffered a dehiscence on sixth day which was immediately repaired with No. 32 alloy steel wire. He was permitted out of bed the following day and discharged on the fifteenth day following the original operation.

Table 87

	Date Out of Bed	Discharged from Hospital	Return to Work
1. C. B.	6		2 months
2. E. A.	6		2 months
3. W. J.	5	18	3 months
4. G R.	6		2 months
5 S. M.	5	11	2 months
6. B. S.	6	23	?
7. M. L.	6	11	7 weeks
8. M. B.	6	14	10 weeks
9. M. K.	5	33 (thrombophlebitis)	3 months
10. R. S.	6	11	2 weeks
11. J. K.	3	15	6 weeks

Comment. It may reasonably be asked why intestinal continuity was not re-established by end-to-end anastomosis in Case 3 and Case 4. In answer it must be pointed out that we have, under almost comparable circumstances, performed end-to-end anastomosis in other cases. In the third case, the first operation was terminated as a Hartmann resection because of soiling incident to a large sigmoidotomy. At the second operation dense adhesions about the rectal stump so increased the technical difficulties

that, in our judgment, a trustworthy anastomosis was precluded with so short a rectal stump. As is well recognized, an unsuccessful anastomosis beneath the peritoneum of the pelvic floor subjects the pararectal fat to a bacterial contamination which can readily spread into a serious retroperitoneal infection. Should the patient survive this infection, he is often subjected to recurring rectal fistulae. In short, it was felt that in the cases cited we have been guided by the principle that the operation must be adapted to the patient and not the patient to the operation. This fourth patient, being 61 years of age, would ordinarily have been left with a permanent colostomy. He was, however, unable to pursue his occupation as a glass blower because of his colostomy. He was given a conception of the risk involved and an effort was made to have him change his vocation. He insisted on operation, possibly because he was a successful glass blower and it was rather late in life for him to learn a new business.

The technic of this operation is essentially that of left hemicolectomy and abdominoperineal proctosigmoidectomy without colostomy and with preservation of the sphincter mechanism, which has been adequately described elsewhere. The excision of the descending colon, splenic flexure and transplantation of the transverse colon require surgical mobilization of these parts, a procedure which is familiar to all colon surgeons.

Although there has been no mortality in eleven cases, the operation is a formidable one and doubtlessly there will be mortality when a significant number of cases have been done.

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CHAPTER 22

Volvulus of the Sigmoid Colon

DEFINITION
INCIDENCE
PATHOGENESIS
SYMPTOMS
DIAGNOSIS
DIFFERENTIAL DIAGNOSIS
TREATMENT
PROGNOSIS AND MORTALITY

DEFINITION

Volvulus of the sigmoid is a form of intestinal obstruction that occurs as a result of torsion or twisting of the bowel upon its mesentery or upon itself.

INCIDENCE

Although volvulus is encountered infrequently in this country as a factor in acute abdominal emergency, it has been reported as a not uncommon cause of intestinal obstruction from clinics in Germany, Russia and Siberia. Metheny[22] cites a series of 496 cases of intestinal obstruction at The King County Hospital in Seattle, from 1934 to 1941, in which 5 were due to volvulus of the sigmoid. At the Cook County Hospital in Chicago, 458 cases of large bowel obstruction were treated between 1937 and 1945; 37 were volvulus of the sigmoid colon, according to Griffin.[9] These cases comprised 2.2 per cent of all intestinal obstructions admitted.[17] Of 520 cases of obstruction observed at the Massachusetts General Hospital, Sweet[33] reports 10 of the sigmoid flexure. Quite recently Lehman[40] cited 24 instances of volvulus in a group of 406 cases of intestinal obstruction. It is interesting to note by comparison the figures reported from eastern European hospitals, for of 215 cases of intestinal obstruction reported by Perlmann[24] from a Russian clinic, 111, or more than half, were cases of volvulus. In addition, Braun[2] and Wortmann, reporting 102* cases seen at Friedrickshain Hospital in Berlin, list 31 cases of volvulus. These observers found the sigmoid to be involved three times as frequently as the cecum and ascending colon.

It may be said that volvulus is more common in men than women. It is uncommon in children and elderly people and extremely rare in infants. The greatest incidence occurs between the ages of 20 and 60 years. Of 119 cases collected from the literature by Giffhorn,[8] the following age distribution was observed:

Age Incidence of Volvulus of the Sigmoid Flexure

10 to 30 years—14 cases
31 to 50 years—46 cases
51 to 71 years—40 cases
71 to 90 years— 8 cases

PATHOGENESIS

There are certain anatomic and pathologic causes that predispose to torsion or twisting of the sigmoid flexure. Anatomically, a long flexure in which the limbs of the loop are closely approximated and which includes a mesentery with a short base of attachment, allows for easy axial rotation and thus predisposes to the occurrence of volvulus.[4] Any factor that will cause narrowing of this base of attachment, such as inflammatory changes, adhesions and cicatrices of its peritoneal layers, predisposes to pedicle formation of the root of the mesentery and encourages rotation of the bowel. The greater occurrence of congenitally longer sigmoid flexures in men than in women accounts for the difference in inci-

dence. It may also be assumed that the greater incidence reported from Europe can be explained partly on the greater incidence of long flexures of the sigmoid that exists there. Curshmann[5] found abnormally long flexures of the sigmoid in 4.2 per cent of postmortems made in Germany, whereas in Russia, Samson[31] found unusually long sigmoid flexures in 20 per cent. This is explained on the basis of the diet of the latter region, made up of large quantities of vegetables which tend to produce great quantities of residual stool, thus elongating and overloading the loop of bowel with feces. The situation of strong, muscular men having less capacity of the abdominal wall renders reposition of the volvulus spontaneously less common. However, the greater room in the female abdomen will permit greater movement, and there is greater liability that torsion will develop, but it also permits a better chance of spontaneous detorsion.

There are a number of pathologic conditions that predispose to volvulus of the sigmoid. Of these, megacolon, or Hirschsprung's disease, is well known. Weeks[38] recently reported one case and reviewed 63 cases gathered from the literature. Melamed[20] reported a case of megacolon complicated by volvulus, and Probstein[27] cited 2 cases of recurrent volvulus of a sigmoid megacolon, one with hepatodiaphragmatic interposition of the sigmoid colon. Narrowing of the attachments of the mesentery by inflammatory processes, diseased lymphatic glands, tumors and cysts may be mentioned as additional causes.[39]

It is apparent that redundancy of the sigmoid and mesentery may be congenital[1, 6] or acquired. The progression of such redundancy to permit volvulus may increase over a period of years. Metheny[21] reports a case of a three-month-old infant with volvulus in whom the congenital factor was the only important one. He also cites a case of a patient 93 years of age who died of a strangulated volvulus. The latter case represents the progression of redundancy aided by the relaxation of age and repeated attacks of partial volvulus to the point of torsion and complete obstruction.

Just what factors must exist to precipitate an attack of volvulus are not clear. The exciting causes must be a combination of the anatomic and pathologic reasons discussed, aided by disturbed function, such as an over-loaded sigmoid, chronic constipation,[11, 35] violent peristalsis from cathartics, trauma or sudden twists of the body, as suggested by Hayden.[10]

Torsion of the sigmoid may vary from 90° to 360° or even more.[23] The tightness of the twist rather than the number of turns determines the degree of occlusion of the bowel lumen and the interference of its blood supply. Necrosis and perforation have been reported in cases of not over 90° in extent and not over 24 hours' duration, while one of 270° and of much longer standing produced no changes. The twist of the sigmoid is usually clockwise, although cases of counterclockwise torsion have been reported.

The pathologic processes that accompany torsion of the bowel vary; in those where torsion develops gradually, both gas and fluid may be found in quantities within the strangulated segment, whereas, if the torsion is sudden and occlusion complete, the fluid in the loop will exceed the flatus present. The distended loop of gut rises rapidly into the abdominal cavity. The degree of interference of blood supply will control the subsequent complications of hemorrhage into the bowel, infarction of its wall, gangrene and perforation.[23] Sepsis is rapid and frequently fatal before necrosis and perforation supervene. Detorsion may occur in acute volvulus as a result of the rapid distension. Free peritioneal fluid and regional peritonitis are natural sequelae. In the so-called subacute or chronic forms of volvulus the torsion does not interfere markedly with the blood supply and early treatment has permitted detorsion.

SYMPTOMS

The symptoms produced by a volvulus of the sigmoid colon are directly proportional to the extent of the pathology produced. Feratrom[7] has recognized three types: (1) the acute type; (2) acute recurrent attacks of short duration; and (3) the chronic atypical with slight or moderate pain. Most cases fit better into two general types, namely, (1) acute and (2) subacute or chronic.

Acute volvulus has an onset short in duration; antecedent lesser attacks of pain and constipation are not rare. Tenesmus and bloody mucus have been reported. Severe generalized cramps, abdominal pain, nausea, vomiting, arrested passage of flatus and feces, and tympanites all suggest signs of a mechanical obstruction. The pain may at first be located in the iliac fossa or pelvis and later generalized. At the onset the pain may be slight and therefore tolerated, so that treatment is postponed. Nearly all patients experience early transient nausea and vomiting, but these symptoms may be delayed or absent. With the loss of blood into the infarcted segment, shock is usually in evidence. When this has passed, the pulse may be only slightly increased and the temperature of a mild grade. After the obstruction has existed for some time, the pulse becomes weaker and the respiration rapid and shallow.

In contrast to the acute type of volvulus described above is the subacute, or chronic, type. The clinical symptoms point usually to an incomplete obstruction. The patient has frequently been subject to constipation and periodic attacks of pain relieved by enema. Obstipation for a day or two associated with cramplike pain and abdominal distension are characteristic of the mild or ambulant attack. When detorsion occurs in the chronic type, much flatus is expelled and the symptoms rapidly subside. Subsequent attacks may well lead to complete obstruction with a more gradual onset of symptoms than is seen in the acute type.

The physical findings associated with the acute type of volvulus of the sigmoid vary. Some may show distention, audible peristalsis and slight abdominal tenderness. A so-called test enema will allow as much as 1000 cc. of fluid under the force of gravity. A scout film will show distention of the sigmoid. Other cases of acute volvulus may disclose severe distention, absence of peristaltic sounds, generalized abdominal tenderness and inability to tolerate more than 500 cc. of an enema. The strangulated loop may stand out prominently and be readily palpable as an elastic mass beneath the abdominal wall. This "stiffening" of the bowel is described as Wahl's sign.[26] A flat film of the abdomen will usually reveal a pattern indicative of gaseous distention and volvulus of the sigmoid.

Physical findings in the subacute, or chronic, type may show a wide variance. Before obstruction occurs, there may be tenderness on the left side, and the redundant sigmoid may be palpable to the left of the navel. X-ray examination by flat film may offer little assistance in the diagnosis, whereas a barium enema may well disclose an obstruction by its abrupt stoppage. A test enema may not permit more than 500 cc. of water to pass. On the other hand, a properly given enema in the knee-chest position may relieve all symptoms. This is not uncommon in the chronic or recurrent type.

DIAGNOSIS

Although the diagnosis of volvulus of the sigmoid may not always be made before operation, a partial or complete intestinal obstruction demanding surgical intervention should be recognized. Ordinarily, signs of intestinal obstruction appear early in volvulus of the sigmoid. Soon after the onset, the affected portion of gut may be palpated through the abdominal wall as an elastic, tender mass. In the later stages, distention and generalized tenderness resulting from peritonitis obscure the early signs, but visible peristalsis may be ob-

served. In infants showing signs of intestinal obstruction, volvulus must be given serious consideration.[31]

Determination of the capacity of the colon by use of a tap water enema is considered of diagnostic importance. The normal colon in an unobstructed adult will usually tolerate from three to four liters of water; inability to introduce 500 cc. of water has been considered helpful in the diagnosis of volvulus of the sigmoid. Tenesmus and bloody mucus in the rectum may be infrequently found.

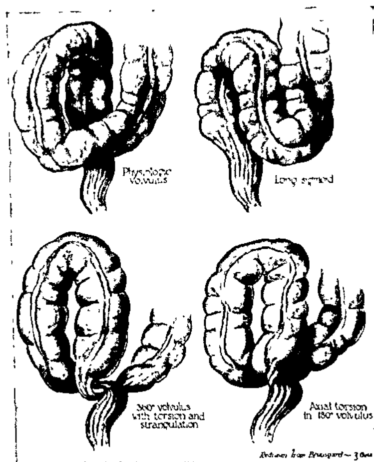


Fig. 650. Various degrees of torsion. (Redrawn from Bruusgard)

Great diagnostic aid is obtained from both a scout film and by the use of an opaque enema. A flat plate will usually show a typical gas pattern. The opaque enema will show an abrupt smooth termination of the filling defect with a normal mucosal pattern in the sigmoid and rectum distal to the obstruction.[30]

Consideration in the differential diagnosis must be given to colitis, particularly from the chronic type of volvulus. Convincing signs of intestinal obstruction are usually lacking or remain well in the background. Carcinoma of the sigmoid must be considered. Here we are aided by sigmoidoscopic examination, the barium enema and the absence of strangulating symptoms. One must be cognizant that volvulus accompanying carcinoma may occur at the sigmoid flexure.

DIFFERENTIAL DIAGNOSIS

In the case of cancer there is usually a slow-growing obstruction and the entire bowel gradually becomes distended. It is

Litvin's[13] observation that the cecum tends to distend most markedly, because of the thinness of its wall, through the transverse colon and finally the descending colon. The latter may show relatively little distention. A roentgenogram will usually delineate the various parts of the colon by the presence of the gas. In contrast, the volvulus is a sudden obstruction. The involved loop of sigmoid becomes markedly distended and rises out of the pelvis. This may be recognized in the roentgenogram.

Mesenteric thrombosis, peritonitis, strangulation of the bowel by a band resulting from previous inflammatory process, acute pancreatitis, strangulation of an internal hernia from some other cause and perforation of the stomach or duodenum may all simulate torsion of the bowel. Careful evaluation of symptoms, signs and laboratory data may be necessary to conclude the diagnosis of volvulus.

TREATMENT

Surgical treatment of volvulus is definitely indicated in most cases. Simple untwisting of the volvulus either with or without passage of a rectal tube or enema with the patient in the knee-chest position may give temporary respite. Hinton[12] reports a case of volvulus which was relieved several times by passing a large rectal tube into the sigmoid via a large sigmoidoscope. He suggests its use in desperate cases in lieu of surgery. Bruusgard[11] presents a substantial series in a ten-year study at the Ullevaal Hospital in Oslo. Where clinical examination discloses no evidence of circulatory disturbance of the sigmoid, proctoscopy and intubation with a rectal tube 60 cm. long and from 6 to 10 mm. in diameter is recommended. This method was employed in 136 instances; successfully in 123 and unsuccessfully in nine. In addition there were four deaths, a mortality of 2.9 per cent.

The plan of surgical attack in acute volvulus will depend on whether the process is seen early to permit simple untwisting of the volvulus or whether the process is seen late, and the pathologic processes make it necessary to consider a more formidable procedure. It must be remembered that the contents of the strangulated loop of bowel are extremely toxic. Even the free peritoneal fluid outside the bowel is potent. Our judgment as far as type of surgical approach must be based then on the amount of distention, the condition of the segment of gut and the circulatory changes existing.

If there is no obstruction or circulatory changes, or even if there has been obstruction which had previously been relieved by preoperative enemas, primary resection with immediate closed anastomosis is the procedure of choice.[32] In torsion of the sigmoid flexure which shows marked circulatory

Kind of Treatment	(Bruusgard) Number of Treatments	Died
None	2	2
Spontaneous reduction	3	
Reduction by enema	2	
Reduction with a barium enema	2	
Reduction with a rectal tube	5	
Reduction with proctoscopy and rectal tube	136	4
Laparotomy and detorsion	10	1
Laparotomy and cecostomy	1	1
Laparotomy and sigmoidostomy	1	
Laparotomy and primary resection	1	
Laparotomy and exteriorization resection	5	5
Total	168	13

Operative mortality 7.7%.
Patient mortality 14.2%.

changes and evidence of devitalization to impair the viability of the bowel, excision or exteriorization should be performed.[10] Rajasingham[24] points out the importance of not untwisting the loop of involved sigmoid to prevent liberation of the extremely toxic contents into the returning circulation. This is a point to be well considered.

Metheny[22] reported 5 cases successfully treated by primary end-to-end anastomosis. He stressed adequate preoperative preparation and the necessity of a surgical technic that insures a gastight and watertight return without impairment of blood supply to the ends of the gut.

The classical description of end-to-end anastomosis by Lockhart-Mummery[14, 15] is an excellent technic to follow. According to Griffin[9] and to collected data from the Cook County Hospital, an exteriorization procedure executed in the presence of a viable bowel gives the best recovery rate. If a gangrenous bowel is present, resection is obligatory, but even in the cases of viable bowel, secondary resection following the exteriorization procedure seemed to be the operation of choice.

Wangensteen[37] points out the advantages of the Mikulicz technic of exteriorization of the bowel in torsion of the sigmoid flexure, which view we share. In some cases, the Rankin[29] type of obstructive resection, which has been recognized as an excellent procedure, is recommended. This may be combined with a cecostomy, if needed, for decompression.[18]

PROGNOSIS AND MORTALITY

The prognosis in volvulus depends on the degree of toxemia produced by the obstruction and the presence or absence of gangrene of the bowel. Early operation in the course of the condition tends to prevent both toxemia and gangrene and may avoid the necessity for resection. It is difficult to evaluate the actual figures of the mortality rate of volvulus, although it is well known that the figure is high. Perthes[26] reports a mortality of 39 per cent in patients submitted to operation, while Perlmann[24] cites an incidence of 46 per cent and Michel[12] 60 per cent. McIvers[16] quotes a 100 per cent mortality from 1898 to 1907, whereas from 1918 to 1927, the rate was 46 per cent in the presence of obstruction. In 13 cases, this writer found a mortality of 55 per cent in cases with interference in mesenteric circulation, and 25 per cent in cases with no interference.

SUMMARY

There are many contributing factors that should aid to decrease the mortality figures. Of these, earlier diagnosis and hence earlier treatment combined with adequate preoperative preparation, sound surgical technic, postoperative care, including the use of the sulfonamides and penicillin, and our increased knowledge of fluid and electrolyte balance are of prime importance. Proctoscopy and intubation may be attempted if gangrene at the site of torsion can be excluded. In the presence of bowel damage or where intubation is unsuccessful, a Mikulicz exteriorization procedure may be chosen. A Hartmann maneuver may be instituted in selected cases. Such comprises excision and bringing out the proximal sigmoid as a temporary colostomy and closing and dropping the distal segment into the abdomen. In the absence of marked distention and gangrene, resection with immediate end-to-end anastomosis may be employed.

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CHAPTER 23

Wounds, Injuries and Rupture of the Rectum

ETIOLOGY
SYMPTOMS
DIAGNOSIS
PATHOLOGY
COMPLICATIONS AND SEQUELAE
PROGNOSIS
TREATMENT
SUMMARY

INTRODUCTION

There is in existence a certain inclination, even among military surgeons, to discredit the experiences gained during wartime. Such a condition is most unfortunate, for it is only necessary to delve into any field of surgical research to realize the value of the contributions which military surgery has conferred upon those following this branch of the profession.

In no other field has it been of greater value than in injuries incident to the gastrointestinal tract. Injuries to the anus, rectum and sigmoid colon have always been more common than might be surmised by a closer scrutiny of the literature.

It can be recalled that only a short while ago, intra-abdominal wounds of the colon and rectum carried a mortality rate of approximately 50 per cent, a rather formidable presentment. A comparison of the mortality rate in the First World War for penetrating wounds of this region with that of the Second, will reveal the magnitude of the accomplishment credited to military surgery. In the former period of conflict, mortality for penetrating colonic wounds was from 50 to 75 per cent; in the second it was approximately 30 per cent.[17] For rectal wounds of a similar nature, the comparable mortality rates were 45 per cent and 10 per cent, respectively. Fortunately, these men were afforded the opportunity of dealing with a multiplicity of various wounds, and the results, to put it mildly, have been amazing. Some of the surgical principles which wrought such seeming magic are not exactly revolutionary, but, with the opportunity which arose to make a detailed study of these many and various types of injury, it became possible to evaluate the various procedures which had been previously recommended and to eliminate those which had been proved valueless.

In the following discussion, the injuries occurring in civilian life and also those that were encountered with greater frequency by the military surgeons are presented.

An attempt has been made to outline some general principles of care which are deemed applicable to both types of injuries.

ETIOLOGY

Injuries to the rectum may be classified either on the basis of etiologic factors or upon the location of the injury in respect to the peritoneal cavity. The latter is somewhat more important insofar as treatment is concerned, while it is important that acquaintance with the variety of agents causative of these anal, rectal or sigmoidal injuries be acquired.

Causative factors may be classified as follows:

1. Wounds of the bowel wall due to:
   a. Impalement, as a result of falling upon some sharp, narrow or elongated object.

b. Sitting on such an object, or any rough or lumpy surface.
c. Foreign bodies, or as a result of instrumentation or treatment.
d. High velocity missiles (bullets, shell and bomb fragments).

2. Rupture of the rectum, either spontaneous or traumatic.
3. Blows of any kind in the fundament of sufficient force to result in trauma to the rectum.

The latter two groups might also be placed under the category of wounds.

Impalement. The rectum and colon are not uncommonly injured by impalement,[9, 10, 27, 39, 40, 72, 75] children being the most frequent sufferers from falls resulting in impalement, but adults also are not exempt from this type of accident. Industrial reports probably feature the greater number of this type of injury among adults.[25, 27, 40, 72, 75] It is quite important, in taking the history, to note the height of the fall, weight of the individual and, if the impaling object has already been withdrawn, its size, shape, angle of entry and the approximate distance it was imbedded (length of blood or moisture stain). A variety of objects has been listed in this connection, notably stakes (iron or wood),[31] branches of trees, stumps of weeds, iron bars, legs of chairs, canes, cut-off corn stalks, rifle barrels, nails, coupling-pins,[10, 25] mop,[60] broom or ax handles, shovel handle,[27] steel hook,[39] pickaxe[75] and sled runner.[9]

Sitting or leaning in a more or less sitting posture on canes, umbrellas, golf clubs, etc., needs but a sudden slip or lurch to result in possible bruising or piercing of either the anus or rectum. Watt[86] recounts the case of a boy who sat on a brass curtain rod and sustained a tear on the anterior wall of the rectum one centimeter in length, just behind the bladder. Other agents mentioned were picket fence,[9] auto and motorcycle accidents[9] and various others. Meyer[55] reported very high mortality rates for sigmoid and rectal perforations due to contamination by fecal contents resulting in terminal peritonitis. Clagget[13] collected 200 cases in 1939, the major portion of which occurred in agricultural occupations; all were males.

Foreign Bodies. These may be either ingested, formed intra-intestinally or passed through the anus, and are perhaps the most common source of rectal injury. Sharp or pointed objects, such as pins, tacks, splinters of bone, glass, etc., invariably abrade or lacerate the mucous membrane, sometimes piercing the intestinal wall. Any foreign body minute enough to be enmeshed in the crypts of Morgagni, such as pins. tacks or larger articles such as fruit stones, dental plates, fecaliths, colproliths, enteroliths, coins, etc., may result in abscess formation, more or less serious, according to location, duration and strength of the intestinal wall. Larger type bodies, usually those passed through the anus, may result in injury through carelessness of forceful insertion, and careless manipulation after insertion. The severity of the injury may be increased by injudicious traction or manipulation attendant on removal of the foreign body by inexperienced persons.

Instrumentation. Rectal injury, subsequent to proctoscopy or sigmoidoscopy is not so infrequent as one would like to claim. *Crohn and Rosenak*[20] gathered 58 instances from the literature, and from a questionnaire, 21 additional cases of perforation as a result of instrumentation. Pearse[63] reported 8 cases of instrumental perforation of the rectosigmoid, 7 of whom were males; 4 of them died. Sallick[70] cites the case of a 70-year-old female resulting from sigmoidoscopy done for lower intestinal bleeding; she had been treated conservatively, subsequently recovering. In the majority of cases in this category, the colonic wall is weakened by colitis. Jakelson and his coworkers[42] reported 11 cases in a series of 145 with the idiopathic type; all of the 11 died of terminal peritonitis; 4 were females and 7 males. Andresen[1] collected 46 cases of perforation by questionnaire as reported by

34 physicians. The explanation for perforation is listed as follows:

Explanation for Perforation	
Thin wall	3
Carcinoma advanced	2
Inflation	1
General anesthesia	1
"H.M C."	1
Term light bulb (broken)	1
Total	9 (19%)
Inexpert Examination	
Intern	2
Internist	2
Inexpert	3
Total	7 (16%)
Total Explanations	16 (35%)

In 12 cases not operated upon, there were 8 deaths, a mortality of 67 per cent. In relation to time of diagnosis, Andresen cites the incidence shown below:

Diagnosis	No. Cases	Patients	Mortality
Immediately	31	10	32%
First 6 hours	36	12	33%
6 to 12 hours	5	3	60%
After 12 hours	5	4	80%
Total	46	19	41%

In relation to the time of operation the mortality rate is shown in the appended table:

Interval	No. Cases	Deaths	Mortality
Immediate	12	1	8%
1 to 6 hours	14	5	30%
6 to 12 hours	2	1	50%
After 12 hours	4	3	75%
Not stated	2	1	50%
Total	34	11	32%

Diverticulitis, carcinoma and self-traumatization were mentioned as additional causative factors. Kaufman, Serpico and Mosig[43] cited three cases, one dying as a result of traumatic perforation of the rectosigmoid and one the result of a self-administered enema. Dodds and Mayeur[21] mentioned misguided efforts at abortion re-

Mortality in Relation to Type of Operation			
Operation	No. Cases	Deaths	Mortality
Closure alone	23	6	26%
Closure with drainage	2	1	50%
Closure with colostomy	2	2	0%
Colostomy only	6	1	17%
Drainage only	1	1	100%
Total	34	11	32%

sulting in perforation. Walkling[84] reported a ruptured sigmoid due to hydrostatic pressure from a water hose. Goldman[30] mentions an instance of a bowel so sharply angulated, due to abdominal adhesions, that the sigmoidoscope was misdirected and pierced the abdominal wall. Other cases of perforation through a normal wall have been noted.[49, 54, 70]

In this class of therapeutic accidents is also included perforation or traumatism by enema tips or nozzles.[69] Pratt and Jackman[67] found 20 such cases in the literature and reported 2 of their own; 8 of the cases died. Thermometers[22, 89] and dilators are also mentioned as causative agents. Many of these mishaps may result from insufficient lubrication or lack of care in insertion. Smiley[74] mentioned giving a patient an irrigating tube for home use in the treatment of stricture. Despite the pain occasioned, the patient inserted the tube, sustaining a penetration of the rectum to which he succumbed. A prolapsed state of the mucosa is also conducive to such accidents. Windfield[89] reported two cases of mucous membrane lesion due to a thermometer, one resulting in severe arterial bleeding. Elvin and Fromm[22] investigated 1,530 necropsies, paying special attention to clinically demonstrated injuries from a thermometer. Rectal changes were disclosed in 158 cases, 96 of them being designated as wounds, presumably of traumatic origin; they had a typical location on the anterior rectal wall.

Wounds Due to High Velocity Missiles. During and following the recent conflict, the literature has been replete with articles pertaining to injuries of the rectum and colon.[4, 6, 7, 8, 16, 19, 24, 26, 32, 33, 34, 38, 45,

b. Sitting on such an object, or any rough or lumpy surface.
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the concentrated force of which is so terrific that clothing offers little or no protection. Hirsch[16] reported a case of rupture during an attack of coughing, with hematoma of the rectus abdominis muscle resulting. Pneumatic rupture, as recorded above, has been seen with increasing frequency in the reports of insurance companies carrying workmen's compensation insurance. Many cases traced to carelessness in the handling of a pneumatic hose or its use against a fellow workman as a practical joke, may end in tragedy. Ide[40] reported that 18 of 26 cases seen by him proved fatal, 5 of them recovering and 2 remaining untraced. Falls have been mentioned as additional causative factors. McLanahan and Johnson[53] report 6 cases which resulted in rupture of the colon and rectum, with the small bowel protruding through the anal orifice. One, an elderly female, fell off a toilet seat. The injured sigmoid was exteriorized, but the patient died. Another was due to the delivery, through the rectum, of a dead, extrauterine fetus. Three days following the procedure, Parry and Saltzman[61] found a circular opening, 4 cm. in diameter, on the anterior rectal wall, and reported it as a traumatic rupture.

The frequency with which perforation follows insufflation at the time of examination has been mentioned previously. It is quite unnecessary to state that great care should be exercised in this maneuver, particularly in those cases where the history reveals the possibility of a colitis being present.

Blast injuries of the rectum are also included in this group. This type of injury was encountered chiefly in the Navy, where men were in the water near bomb or shell explosions. It was also seen occasionally in the ground forces, due, in this case, to large shell or bomb explosions.

Martin[50] reported a case of rupture due to immersion blast injury which was located on the anterior rectal wall above the peritoneal reflection; death ensued 52 hours later following a colostomy.

Blows. Rectal injury sometimes results from blows, either direct or indirect, sustained in falls upon flat, hard surfaces. Here, too, the possibility of fracture of the pelvic bones is a threatening complication. McKenney[51] mentions two instances of sloughing of perirectal tissues due to kicks delivered by husbands to their wives. Fortunately, both women recovered, one being forced to sacrifice one third of the sphincter muscle.

SYMPTOMS

Pain, hemorrhage and shock of varying degree are usually encountered in injuries to this portion of the intestinal tract.[3, 6, 9, 11, 12, 13, 14, 16, 17, 18, 24, 28, 29, 31, 32, 33, 34, 35, 37, 38, 42, 43, 44, 50, 52, 57, 59, 60, 62, 65, 67, 71, 72, 73, 75, 77, 78, 79, 82, 83, 85, 87, 88] All cases so injured mentioned pain, and the cases reported by these investigators recorded the presence of hemorrhage and shock as part of the presenting symptomatology. Pain over the pubic region may indicate a perforated bladder, as may urine passed rectally or the presence of blood and feces in the urine.[12, 24, 75] Abdominal pain, meteorism and vomiting are common where peritoneal perforation has occurred.[12, 38]

DIAGNOSIS

Injuries to the anus and lower rectum do not present undue difficulty in diagnosis, although this does not obtain where the bowel above, especially the sigmoid, is involved. Feder[26] reported that digital examinations as a means of diagnosis often failed to reveal rectal wounds. Through roentgen diagnosis, Terrel[83] demonstrated the presence of shrapnel metal in the lumbar region in his case of rectal trauma. Seybold, Black and Jackman[72] advocated both digital and proctoscopic examination. A diagnosis was made in one of their cases by roentgenologic discovery of air under the diaphragm. Wilkinson, Hill and Wright[87] suggested roentgenologic study as an aid in diagnosis, especially in the absence of a wound of exit of the bullet or missile. Also,

[49, 52, 56, 57, 58, 59, 60, 61, 70, 77, 80, 83, 85, 87] These have been grouped under the heading of missiles, since a wide variety of objects, such as bullets, bomb and shell fragments, and mine fragments (including wood, rocks, ball bearings, nails, screws and other materials, as well as plastic objects). It is notable that bullets are rarely found in the rectum, nor is it usually the portal of entry.[19, 24, 34, 49, 58, 83] The most common site for the entering wound is the abdomen or sacral region, the latter portal of entry being reported by Morgan[58] by way of passage through the buttocks; this is not infrequent, for cases have been reported by Feder,[26] Terrell,[83] Hamilton,[34] Wilkinson[87] and Watson.[85] Fragments of bombs, shells and mines caused 76 per cent of rectal injuries and 24 per cent were due to bullets, in Hurt's series.[38] Reports of shell fragments lodging in the sacral area, sometimes splintering the pelvic bone and thus adding to recovery hazards, were recorded by Hurt,[38] Morgan[58] and Hamilton.[34] Terrel[83] described a wound of entry in the left buttock which resulted in a sacral fracture. Peek[61] had dealt with many police cases of bullet wounds, stressing the need of careful examination lest an unsuspected rectal injury be neglected. Blaisdell,[9] in reviewing traumatic rectal injuries, listed perineal complications due to fistulous formation. In a personal communication to the author, Ewell[24] reported the case of a male with extraperitoneal perforation of the rectum and retroperitoneal cellulitis. Drainage of the wound area by extirpating the coccyx was done following a loop colostomy.

Laufman[49] cited the actual incidence of entrance into the rectum as being very low, only 6 per cent of their buttock wound cases being in this category. The commonest associated injuries were penetrations into the peritoneal cavity, urinary bladder and urethra, the sciatic nerve, the spinal cord and compound fractures of contiguous bony structures. One case was shot through the great trochanter of the femur.

Morgan[58] states that missiles may occasionally be found between the rectum and sacrum and that of 21 cases studied, seven were undiagnosed until feces and flatus passed from the wound.

Croce and his co-workers[19] stated that anal perforations usually resulted in ischiorectal abscess formation. Feder[26] reported 285 cases of buttock wounds, of which 176 were classed as minor; 2 of the rectal wounds were visible to the naked eye. Of 26 of them who were sigmoidoscoped, all had rectal trauma. Twenty-three were perforations; 3 had no perforations but severe hemorrhage was present. Eleven per cent of the cases died. Twenty-eight had rectal injury, and no mortality ensued when the wounds were limited to the rectum and buttocks.

Hamilton[34] mentioned that shrapnel and bullets caused the majority of colonic and rectal injuries, 36 per cent being reported in the colon exclusively. In 20 per cent, the wound of entry was in the buttocks; in 60 per cent, in the anterior abdominal wall, and in 20 per cent, in the dorsal region.

The severity of the ascending retroperitoneal cellulitis which follows inadequate drainage of the retrorectal area has been mentioned in several instances by various military surgeons.

Rupture. Spontaneous rupture may generally be traced to strain, such as in defecation,[2, 47, 81] lifting great weights or coughing.[14] Christopher reported a case due to sudden shifting of the major portion of weight of a heavy gasoline engine. Crushing injuries to the abdomen or pelvis, especially if the pelvic bones are fractured or splintered, may result in rupture. McLanahan and Johnson[53] report a case due to crushing injury which resulted in death. Another case reported by McLanahan[52] and Murray was that of a twelve-year-old female child, due to external violence; the child had been caught in a cave-in.

Pneumatic pressure has been indicated as a cause, Swenson and Harkins[82] tabulating 65 complete rectosigmoid ruptures and 10 incomplete, due to compressed air,

the concentrated force of which is so terrific that clothing offers little or no protection. Hirsch[38] reported a case of rupture during an attack of coughing, with hematoma of the rectus abdominis muscle resulting. Pneumatic rupture, as recorded above, has been seen with increasing frequency in the reports of insurance companies carrying workmen's compensation insurance. Many cases traced to carelessness in the handling of a pneumatic hose or its use against a fellow workman as a practical joke, may end in tragedy. Ide[40] reported that 18 of 26 cases seen by him proved fatal, 5 of them recovering and 2 remaining untraced. Falls have been mentioned as additional causative factors. McLanahan and Johnson[53] report 6 cases which resulted in rupture of the colon and rectum, with the small bowel protruding through the anal orifice. One, an elderly female, fell off a toilet seat. The injured sigmoid was exteriorized, but the patient died. Another was due to the delivery, through the rectum, of a dead, extrauterine fetus. Three days following the procedure, Parry and Saltzman[61] found a circular opening, 4 cm. in diameter, on the anterior rectal wall, and reported it as a traumatic rupture.

The frequency with which perforation follows insufflation at the time of examination has been mentioned previously. It is quite unnecessary to state that great care should be exercised in this maneuver, particularly in those cases where the history reveals the possibility of a colitis being present.

Blast injuries of the rectum are also included in this group. This type of injury was encountered chiefly in the Navy, where men were in the water near bomb or shell explosions. It was also seen occasionally in the ground forces, due, in this case, to large shell or bomb explosions.

Martin[50] reported a case of rupture due to immersion blast injury which was located on the anterior rectal wall above the peritoneal reflection; death ensued 52 hours later following a colostomy.

Blows. Rectal injury sometimes results from blows, either direct or indirect, sustained in falls upon flat, hard surfaces. Here, too, the possibility of fracture of the pelvic bones is a threatening complication. McKenney[51] mentions two instances of sloughing of perirectal tissues due to kicks delivered by husbands to their wives. Fortunately, both women recovered, one being forced to sacrifice one third of the sphincter muscle.

SYMPTOMS

Pain, hemorrhage and shock of varying degree are usually encountered in injuries to this portion of the intestinal tract.[3, 6, 8, 11, 12, 13, 14, 16, 17, 18, 24, 28, 29, 31, 32, 33, 34, 35, 37, 38, 42, 43, 44, 50, 52, 57, 59, 60, 62, 63, 67, 71, 72, 73, 75, 77, 78, 79, 82, 83, 85, 87, 88] All cases so injured mentioned pain, and the cases reported by these investigators recorded the presence of hemorrhage and shock as part of the presenting symptomatology. Pain over the pubic region may indicate a perforated bladder, as may urine passed rectally or the presence of blood and feces in the urine.[12, 24, 75] Abdominal pain, meteorism and vomiting are common where peritoneal perforation has occurred.[12, 38]

DIAGNOSIS

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in the difficult cases, they made use of the abdominal tap. Peritoneal tap using a spinal puncture needle was performed in all four abdominal quadrants. In their series, eight

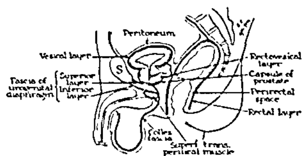


FIG. 651. Diagrammatic representation of sagittal section of the pelvis showing distribution of endopelvic fascia and planes along which infection can travel in rectal wounds. (H. Laufman: Surg., Gynec. &. Obst. 82:219.)

abdominal taps were made; in five, the tap was positive. Brown,[11] in reporting cases of spontaneous perforation of the pelvic colon from within, advised proctoscopy as an aid in differential diagnosis in diverticulitis and the presence of foreign bodies. Goliher, King and Simmons[31] stated that reduced liver dullness was an aid in the diagnosis of perforative injuries produced by exploding depth charges in water and that in the nonperforative group he found less tenderness and no rigidity as a diagnostic help. He concluded that it is not too difficult to diagnose cases of perforation. Hamilton and Duncan[35] advocated peritoneoscopy as a valuable aid, since they had used it in 15 of their cases without an error, and 7 of the cases were spared surgical intervention. Stabler[78] found that an aid in diagnosing abdominal wounds was the use of a "rotary movement" on palpation; he believed that it may be the only maneuver that will elicit abdominal distress. He advocated its use by the same technic in making rectal examinations.

PATHOLOGY

It is essential that an understanding of the pathology of these wounds is possessed by those who may be called on to treat them from a rational surgical standpoint since one rarely encounters two injuries identical in every way. For practical consideration, perforating or penetrating wounds may be divided into three groups: (1) Extraperitoneal; (2) Intraperitoneal, and (3) combined intraperitoneal and extraperitoneal wounds.

Infection is, quite obviously, the complication which follows fecal contamination of the tissues in the region of the bowel perforation. The organism present in the fecal material is one of the usual contaminants, such as *Escherichia coli, Streptococcus faecalis, L. acidophilus* and the *Clostridium welchii.* The last organism was found present moderately often. One of the author's co-workers observed two cases of gas gangrene following penetrating wounds of the rectum.

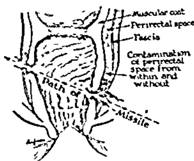


FIG. 652. Diagram of coronal section of rectum showing the mode of contamination of the perirectal space from within and without. Width of perirectal space exaggerated. (H. Laufman: Surg., Gynec. & Obst. 82:219.)

Following local inflammatory reaction at the site of the opening in the bowel wall, the infection may involve the wound tract, but more frequently the latter becomes closed off and a cellulitis develops. Laufman and Morgan[49, 58] have both invited attention to the common avenues of spread along the fascial planes. The accompanying diagram illustrates graphically how this occurs anatomically (Figs. 651, 652).

Briefly, in regard to rectal wounds, when the injury is situated below the peritoneal

reflection, the usual complication is an abscess, which may be present in the ischiorectal fossae, the infralevator or supralevator areas, or retrorectally, depending on the location of the injury and the path traveled by the infection. Treatment is essentially the same in these cases as that described in the chapter on abscesses (Chap. 6).

Where the injury is located above the levators or it involves the retrorectal space, the infection travels upward retroperitoneally behind the endopelvic and transversalis fascia. Perinephritic and retroperitoneal abscesses are frequently a complication. A few similar cases were observed by Morgan when the perirectal fat was injured and liquefaction necrosis and infection were superimposed. Retroperitoneal injuries to the sigmoid result in the same type of infections.

Intraperitoneal large bowel penetrations or perforations result in peritonitis with pelvic, abdominal, subhepatic and subdiaphragmatic abscesses occurring quite frequently.

In the combined type of wound, any or all of the above processes may be superimposed upon these injuries. Colcock has also called attention to the fact that quite frequently osteomyelitis occurred following coccygectomy.

COMPLICATIONS AND SEQUELAE

Peritonitis, hemorrhage and perforation of the bladder are complications of serious import. Naunton Morgan[58] believed that the severe, bursting type of rectal injury is complicated by retraction upward of the anorectal area and isolation of the anus from the perianal skin, due to the disrupting effect of a missile in the loose connective tissue while the pelvic muscles and sphincters are tightly contracted. In infected buttock wounds, the infection complicates the picture by upward retroperitoneal spread. Pelvic peritonitis secondary to traumatic perforation was reported by Kaufman, *et al.*[43] The bladder was not considered perforated on account of the distention present. However, on passage of a catheter, almost pure blood was withdrawn, and penetration appeared a certainty, although the mechanism of the distention needed clarification. At operation for the concomitant rectal wall laceration, adequate retraction gave a good view of the bladder base, in which appeared a large rent; the bladder, filling up, had failed to empty into the rectum, due to the valvular perforation, a triangular flap of mucosa overlying the hole through the mucosa and muscle effectively preventing any potential leakage. Pratt and Jackman[67] report stricture and cellulitis from sloughing of the rectal walls following perforation by enema tips due to the solutions used, also the presence of a severe chemical peritonitis. Wound disruption due to suture breakage was cited by Blaisdell[9] as a complicating factor. Hamilton[31] stated that hemorrhage and peritonitis were complicating factors in the majority of his cases. Ewell[21] reported cellulitis and urinary retention as complications in his case of gunshot wound. Third degree perineal lacerations were complicating factors concomitant with presenting rectal pathology cited by Barrett.[5] Bunch[12] reported a secondary generalized peritonitis as the cause of death in his case. Peritonitis secondary to retroperitoneal abscess formation in 3 cases, resulting in their deaths, was reported by Naunton Morgan[77] in his series of war casualties. Another case developed pyemia as a result of a blood transfusion, subsequently dying. Wilkinson, Hill and Wright[87] reported clinical peritonitis, pneumonia, evisceration, infected retroperitoneal hematoma and intestinal obstruction due to adhesions as postoperative complicating factors. Incendiary bullets resulting in complicating sequelae were reported by Gordon-Taylor,[33] and subsequent necrosis. The same author, in another publication,[22] reported secondary hemorrhages, visible through the sigmoidoscope, as sequelae to

severe blast injuries sustained by a group of war casualties in England. Goliher, King and Simmons[31] cite subperitoneal and intramural hemorrhages of the bowel wall as secondary complications to blast injuries incurred in water, resulting in melena and residual abscess formation. Jakelson, McClure and Sweetsir[42] report 11 cases in a series of 145 with idiopathic ulcerative colitis as a complicating factor in perforation of the bowel, followed in each case by peritonitis and death for all 11.

Severance of the sphincter muscles is also a serious factor. Barrett[5] regards this condition as a herniation and advocates subsequent perineorraphies and sphincter repair.

Abscess formation may prove troublesome but ordinarily responds to the usual methods employed for correction. Blaisdell[9] reports cases having this complication, as does Croce, Johnson and Wiper.[19] Christopher[14] cited incisional abscess involvement; Naunton Morgan[57] reported retroperitoneal abscesses in his war casualties; Wilkinson, Hill and Wright[87] gave subphrenic abscess as a complication in their series. Fistula formation was reported as a sequela.[9, 79]

The mere presence of a foreign body within the intestine may lead to a fatal peritonitis.[23] Again, the patient's precautions against harm may complicate a mere abrasion by transforming it into either a wound or perforation.

PROGNOSIS

So far as prognosis is concerned, the operative mortality in those cases receiving prompt attention is approximately 50 per cent. Colcock[17] stated that an outstanding contribution to military medicine has been the reduction in mortality following traumatic perforation of the colon from 50 to 75 per cent in World War I, to approximately 30 per cent in the war now passing into history.

He further stated that morbidity rates, however, still remain disturbingly high; few patients recover without one or more complications, such as wound infection and separation, evisceration, colostomy retraction or secondary abscess formation in the abdominal wall, peritoneal cavity, subphrenic space or the pleural cavity. In a detailed study of 21 patients, it became apparent that, following perforation, the most important factor precipitating complication was retraction of the colostomy stoma, due to exteriorization under tension. Where tension was present, loop retraction invariably occurred. Without tension and with a spur long enough to permit subsequent extraperitoneal closure, exteriorization, in their cases, was accomplished by adequate initial mobilization. Concerted effort toward achieving primary wound healing, bowel exteriorization without tension and the formation of a double-barrelled colostomy of adequate length, under circumstances existent at front line stations, lowered the mortality rate.

Prognosis in delayed cases is not too good, being close to 90 per cent. Hurt[39] cited 39 cases of colonic and rectal injuries treated at forward stations in which the average time interval before being seen was 15 hours, but in his experience short time lapse did not contribute to decreased mortality rates, all of the casualties having had peritoneal contamination with feces. Hamilton[34] found peritonitis to be the contributing factor, but the mortality rate varied directly with the amount of hemorrhage present. Clagget[15] cited, together with Black, mortality rates of 75 per cent where the peritoneum had been entered in cases of rectal impalement, and 10 per cent for nonentry.

Naunton Morgan[57] stated that the relationship between time lag, site of injury, recovery and mortality was in direct ratio to the promptness of intervention and that, though the number of survivors was approximately equal for each colonic segment involved in battle casualties, there was a

marked fall in the number of survivors operated on within the first six-hour period. McLanahan and Johnson[72] found the prognosis very poor in cases of evisceration, which presents an added reason for the sented abdominal contusions, 4 were perforations, and 3 of these latter 4 subsequently died. In crushing injuries to the bowel wall, Poer and Woliver[65] cited 2 cases with colonic involvement with death as the out-

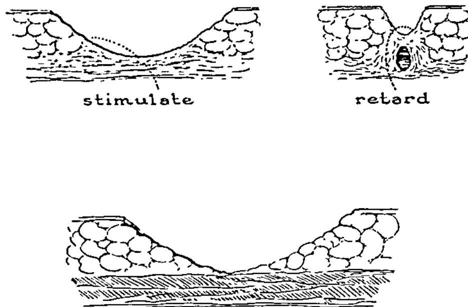


FIG. 653. H. E. Bacon and T. F. Reuther: S. Clin. North America, 17:1809.

early correction of rectal prolapse. Wilkinson, Hill and Wright[87] reported the prognosis grave in abdominal gunshot wounds. Of 115 penetrating wounds, 74 were admitted in shock; 57 of them died, a mortality rate of 77.03 per cent. Peritonitis was the causative factor in the death of 20. Jacobs[41] postulated grave prognosis in depth charge blast cases, especially when seen late following injury, abdominal distention being so pronounced and the cavity so full of gas and feces that surgical intervention was of little or no help. In 12 cases seen from 18 to 20 hours following injury, 8 presented abdominal contusions, 4 were perforations, and 3 of these latter 4 subsequently died. In crushing injuries to the bowel wall, Poer and Woliver[65] cited 2 cases with colonic involvement with death as the outcome. In reporting 145 cases of idiopathic ulcerative colitis and perforation of the bowel, Jakelson, McClure and Sweetsir[42] listed 11 of the cases with perforation as developing secondary peritonitis resulting in death, the prognosis being invariably grave in this type of involvement.

TREATMENT

The type of treatment depends on the location of the injury, the extent, lapse in time and the ingenuity, skill and experience of the surgeon. Time is the all-important element if peritonitis is to be avoided.[9, 12, 11]

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For rectal injury above the sphincter, double-barrelled sigmoidostomy is preferred. Wangensteen suction is mandatory in all cases. In impalement injuries, Seybold *et al.*[72] advise omitting colostomy where bowel closure may be effected satisfactorily, closure was done on 28 cases; all were successful. *Sulfathiazole* was routinely employed. McLanahan and Johnson[52] did a colostomy in a case of spontaneous rupture of the sigmoid, through a left muscle-splitting incision. Crystalline sulfanilamide

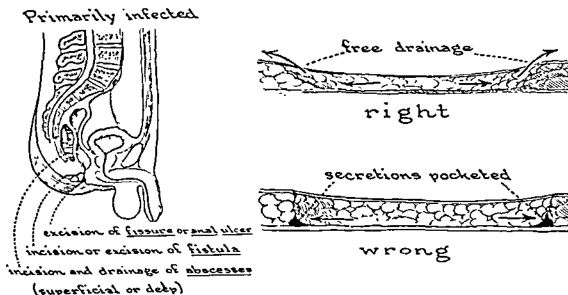


Fig. 654. H. E. Bacon and T. F. Reuther: S. Clin. North America, 17:1809.

but in the presence of severe perineal lacerations, colostomy may prevent infection and should be performed. Two of their 7 cases died; an attendant high morbidity was present in the other cases. Martin[50] did a colostomy on a case of immersion blast injury to the rectum above the peritoneal reflection; the patient died 52 hours postoperatively. Fansler states that where perforation has occurred above the peritoneal reflection, immediate laparotomy should be performed, whether the case is seen early or late. Quénu[63] believed that ample excision of dead tissue in the rectum offers more protection than colostomy against pelvic cellulitis and diffuse gangrene and reserved colostomy for anal injuries. Morgan,[57] in a report on 132 cases of war wounds of the colon, stated that extraperitonealization was done on 74 cases, including 3 nonpenetrating wounds; 16 of them died. Colostomy was used as an adjuvant to guard against postoperative infection; the patient died 62 hours following operation.

Sloan[73] advocates the use of sulfonamide therapy and transfusions, stating that these two measures can effectively reduce the mortality of perforating abdominal wounds; 146 cases were treated at Johns Hopkins Hospital, 91 gunshot and 55 stab wounds. Exploratory procedures were done on 87 cases with 27 deaths, or 31 per cent mortality, during the *period from 1925 to 1943*. During the period from 1939 to 1943, there were 6 deaths in 59 cases, a mortality of 10.1 per cent, attributed chiefly to the measures mentioned above.

Sparkman,[77] in treating colonic injury in amphibious warfare, stated in part that the procedure of exteriorization in large bowel injuries had been found particularly valuable and was considered one of the impor-

[31, 38, 50, 52, 57, 67, 72, 73, 77, 83] The factors of early blood transfusions,[10, 18, 31, 41, 59, 78, 87] early exploration[37] and crushing injuries have been discussed.[21, 41, 65, 81]

For wounds of the lower rectum, irrigation and, if necessary, suture, are usually sufficient. Naunton Morgan[58] found suturing contraindicated in war wounds of the rectum, especially in the bursting type, the sutures invariably sloughing and thereby predisposing to infection. He advocated drainage of extrarectal tissues in extensive rectal lacerations, sphincter preservation whenever possible, and wide dilatation and insertion of tube for drainage. Smith[75] did not suture rectal wall perforation because of potentially infective dead space occurring between the sutured bladder and rectum without provision for drainage. Blaisdell[9] did not advise suturing because such wounds have a tendency to becoming fistulous; mismanagement by suturing may cause sinus or fistula formation either totally incurable or requiring mutilation for cure far greater than the extent of the original wound.

Abscesses in this region ordinarily respond well to incision and drainage. In preventing their formation, "saucerization" of the wound, even if normal tissues are sacrificed, is recommended. Wilkinson, Hill and Wright[87] report the development of a subphrenic abscess following perforation of the small gut, the patient dying six days following drainage.

Pelvirectal wounds and abscesses and intraperitoneal injuries are more serious. Laparotomy with probably a temporary colostomy is, as a rule, the only choice in such cases, and the sooner it is performed, the better will be the patient's chances for ultimate recovery.[9, 58, 75]

Croce *et al.*[19] advise sigmoidostomy in cases of injuries of the extraperitoneal rectum. Hurt[38] stated that suturing was done for perforations at the rectosigmoidal junction and colostomy was done above it. For moderate injuries, loop colostomies were done; more severe injuries requiring colonic resection were performed by the Mikulicz procedure. Primary suture of the colon in unprepared cases was avoided in each instance. At first, loop colostomies were instituted for rectal injuries, but this did not prevent fecal contamination from below, so the spur type was adopted.

Swensen and Harkins,[82] in treating rectosigmoid rupture by compressed air, did a transverse colostomy in one of their cases. Blackburn[8] found exteriorization and colostomy to be the guiding principle for rectal wounds treated in the field. He stated that coccygectomy or the perineal approach was rarely needed in the presence of hemorrhage but may be necessary as a subsequent procedure for infection. In all colostomies he stressed spur formation with closure of the lateral gutter. Feder[29] stated that endoscopy was a standard procedure in buttock wounds. In war wounds, surgical repair with colostomy offers the only hope. Kirchmayr lamented the fact that in wartime approximately half the cases are not seen until from four to seven days following injury. Feder, in treating wounds of the buttocks and rectum, reviewed 28 cases, all operated on with no subsequent pelvic cellulitis; the mortality rate was 11 per cent; all had other injuries. Sigmoidostomy with ample spur was preferred for intraperitoneal wounds; for rectal involvement or extensive sigmoidal injury, transverse colostomy was done. He advocated injecting the distal loop with 20 per cent succinylsulfathiazole once each day. Terrel[83] did a double-barrelled loop colostomy on a case of penetrating shrapnel wound of the rectum; the upper loop was clamped; a suprapubic cystotomy was concomitantly performed for bladder complication.

Hamilton[34] advocated careful exploration, swabbing the pelvis in the absence of blood or perforations. For explosion injuries, double-barrelled colostomy with spur formation is advocated; where impossible, transverse suture and proximal colostomy.

RESULTS IN 72 CONSECUTIVE CLOSURES OF COLOSTOMIES DONE FOR BATTLE WOUNDS OF THE COLON (Sanders *et al.*[90])

	NUMBER	PER CENT
Failure of closure	2	2.8%
Wound infection	2	2.8%
Healed by 14th postoperative day	70	92.8%
Persistent sinus with drainage	0	....
Pain at site of closure	0	....
Hernia at site of closure	0	....
Stenosis at site of closure	1 (followed end-to-end suture)	1.4%
Obstructive symptoms at site of closure	0	....

due to the stress of battle. At times there was no spur; at times it was twisted, or the vessels were turned so that clamping was a hazardous procedure. The second type was due to trauma, often situated in bizarre locations; often much of the bowel was missing. For anastomotic procedures the bowel was cut straight across, for severance at 45° would make a 90°-angle, throwing the stress on suture lines at the fulcrum. Following opening of the peritoneal cavity, bowel ends were mobilized, the cicatrix excised and the viscera restored to anatomic semblance; end-to-end anastomosis with final closure of the wound by Coller's method was performed; sulfathiazole, succinyl type, was used for intraperitoneal procedures, sulfanilamide topically and sulfadiazine orally in cases of threatened sepsis. Gas and ether were used in operative procedures.

Jakelson, McClure and Sweetsir[42] studied 145 cases of idiopathic ulcerative colitis with concomitant perforation of the bowel in 11 of them, followed in each case by peritonitis; all of the 11 died. Ileostomy was done on 4 cases. In only one case did a transverse colonic perforation occur following ileostomy. Three of the cases had multiple perforations; one had two in the ileum; in another, there were three perforations in the sigmoid and a third in the hepatic flexure and cecum.

Pearce and his associates[62] described experiments revealing that sulfathiazole introduced intraperitoneally in normal dogs in microcrystalline form was more rapidly absorbed than the crystalline variety, compared on the basis of drug concentration in the plasma. The microcrystalline type injected intraperitoneally as a suspension gave higher concentrations intraplasmally than did comparable amounts by insufflation, although response to the former was nonuniform. High and sustained concentrations intraplasmally may be obtained by intraperitoneal microcrystal suspension injection. Simultaneously collected samples of blood from the portal vein and heart contained practically identical concentrations of drug, from 60 to 360 minutes following intraperitoneal administration either as crystals or microcrystals.

An interesting observation was made recently by Colcock,[17] who, in studying postoperative problems following colonic perforation, found that ease and safety of future restoration of bowel continuity depended chiefly on the construction of a five-inch or six-inch double-barrelled colostomy spur. Once mobilization has been obtained, the rapid approximation of two loops, with the use of one or two rows of seromuscular sutures to unite the longitudinal bands, should not, ordinarily, increase the operative risk and should permit division of the

tant advances in military surgery in the present war. The damaged bowel segment was exteriorized by drawing it out through a separate incision, *preferably in the flank*; spur formation greatly facilitated closure. The Levin tube and Wangensteen suction, together with sulfanilamide, saved many lives in the prevention and treatment of peritonitis. Wilkinson, Hill and Wright,[87] in treating penetrating abdominal wounds, advocate immediate exploratory laparotomy irrespective of the condition of the patient, especially in the presence of hemorrhage. Sulfanilamide was employed in 27 instances intra-abdominally; sulfonamides were used postoperatively; 8 of the patients survived, and 19 died, a mortality rate of 70.4 per cent. This indicated that the use of sulfonamides had not appreciably lowered mortality figures. Its use is still advocated in helping to prevent peritonitis, but it certainly cannot and never will serve as a substitute for competent surgery. Penicillin was used in 5 cases; its use postoperatively was advised. Gardiner[28] used a fine suspension of sulfapyridine in saline intra-abdominally; in his opinion, this was the most favorable way to use the drug. Gordon-Taylor,[33] in the treatment of abdominal injuries due to depth charge concussion, advises suture in preference to resection in cases of established infection, with local use of the sulfa drugs, drainage and proximal colostomy, which he advises to be done prior to the occurrence of infection. The same author, in another publication,[32] advises never to turn a patient over following laparotomy. He advocates separate flank incisions rather than transverse extensions of rectus incisions in treating this type of injury. Clark,[16] in an article on colostomy in gunshot wounds of the colon, stated that in 40 per cent of cases other viscera are involved. In World War I, only 40 per cent recovered, in this present war 70 per cent, due principally to exteriorization procedures with concomitant blood and plasma transfusions. Where exteriorization was not feasible, a tied-in Paul tube is recommended. In the presence of severe involvement a proximal colostomy was done, as suture and replacement were increasingly dangerous due to bowel contusions which predisposed to injury. Where the rectum was involved, it was sutured; coccygectomy was performed for drainage. Ogilvie[60] believed that excision of the damaged loop of colon was much safer than suture; he did not advise end-to-end anastomosis and cecostomy but advocated a Mikulicz type of resection. Watson[85] did not advocate colostomy for extraperitoneal lesions, but did find them applicable for the intraperitoneal type. The transverse type was recommended for rectal involvements. Powdered sulfa drug insufflation was used routinely. Retroperitoneal tissues were drained through the wound of entry or from below, with concomitant coccygectomy. Ogilvie[59] stated that exteriorization was the greatest single factor emerging from war surgery of colon injuries. He advised that small colonic lacerations be brought out as a loop colostomy and the larger ones be treated by use of the Mikulicz procedure. Injury to fixed colonic portions was repaired, sulfa powder insufflated, retroperitoneal stab wound for drainage and a proximal colostomy done. All rectal injuries, according to the author, require colostomy procedures. He found later closure of the colostomy difficult due to infection, cicatrices or improper spur formation; he advocated a two-inch spur. The transverse type of colostomy was recommended for sigmoidal involvement. Sulfadiazine in gelatin and saline suspension was found best for intra-abdominal use. There were no resultant postoperative adhesions. Colcock[18] did 23 cases of traumatic colonic perforations by the Mikulicz procedure. Keene,[44] in his article on reconstruction of colonic wounds, stated that two types of colonic fistulae were seen. One was the double-barrelled colostomy done by the front line surgeon, not often the usual type,

a portion of the sacrum and coccyx that is already injured in order to remove bone fragments or the foreign body. Wide and thorough débridement of all wounds is definitely mandatory. Where the missile has traveled upward through the extraperitoneal portion of the bowel into the pelvis and abdomen, it is preferable to do the perineal phase first in the lateral position, since less shock attends the procedure. This phase should be done last when intra-abdominal hemorrhage is present or suspected. Drainage of the extraperitoneal wound is instituted and the intraperitoneal wound is treated according to the above recommendations.

Anal wounds may be frequently treated from a conservative standpoint. However, where the sphincter is injured at two points, if massive wounds are present or the urethra is injured, it is best to do a proximal colostomy.

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partition with safety and insure adequate bowel lumen following subsequent extraperitoneal closure. With ample spur length and complete partitional obliteration, the colostomies can be closed with minimal apprehension of postoperative leakage. Colostomy closure was possible in approximately 50 per cent of the series.

In pneumatic rupture, Ide recommended gradual release of peritoneal air pressure by inserting a hollow needle into the cavity, which relieved the shock and helped to improve the patient as an operative risk. In all cases of perforation or rupture, chances for improvement are increased almost 50 per cent if the patient is examined and treated immediately or, at the most, within a twelve-hour period. In operating on a case of ruptured sigmoid due to compressed air, Swensen and Harkins[62] reported that the abdominal cavity was markedly tympanitic, and on opening it, from two to four litres of air rushed out; four lacerations were found in the rectosigmoid, two incomplete and two complete; one was longitudinal and was sutured longitudinally; the other, with complete loss of tissue, was sutured transversely.

SUMMARY

In retroperitoneal injuries without marked loss of bowel wall, the colon should be mobilized and the bowel exteriorized by means of a double-barrelled colostomy having a definitely adequate spur from 10 to 12 centimeters in length along the antimesenteric border. It is essential to have sufficient bowel mobilized so that at least from 4 to 7 centimeters will protrude above the skin. This latter precaution tends to prevent the complication of retraction arising, which, when it does occur, proves very troublesome. Some operators prefer the simple loop colostomy in these cases, but, in our opinion, the double-barrelled type is preferable for a number of reasons, which have been postulated by Colcock and others.

Wounds in the mobile portion of the sigmoid should be treated in the same fashion. We have found it unnecessary to close the left colic gutter, but most certainly stab wound drains should be placed in this area and in the pelvis. Where possible, Babcock sump drainage should be employed.

Sulfonamides (sulfadiazine or sulfathiazole) are still advisable postoperatively, in our opinion, where gross contamination has occurred. Their use has been discussed elsewhere. Streptomycin and penicillin intraperitoneally have proved efficacious in these cases and should be used in large amounts initially since the organisms present rapidly become resistant.

Where the wound is located too low for mobilization, it should be sutured with double layers of catgut, the outer layer of which should be interrupted. Some surgeons prefer this outer layer of suture material to be nonabsorbable, either silk, cotton or alloy steel wire. A proximal colostomy of the double-barrelled type is again performed. (Here, as in other cases, it is preferable to bring the bowel out through a separate incision.)

Extraperitoneal injuries should first be explored from the perineal approach. A transverse incision below the coccyx or a parasacral incision may be used. We prefer the former and, where proved inadequate, it may be carried upward lateral to the sacrum, through the gluteus maximus, sacrococcygeus ligament, sacrotuberous ligament, posterior sacro-iliac ligament and the endopelvic fascia. The latter, or the fascia propria, may be opened through the transverse incision without removing the coccyx and, unless hemorrhage is present, there is no need for greater exposure because closure of the rent in the bowel is unnecessary. Attempts at closure usually result in a breakdown; consequently, adequate drainage should be assured and a proximal colostomy performed.

Where the wounds are complicated by bony injury, it may be necessary to remove

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here, too, children comprise a large percentage of cases. Buttons, toothpicks, pins, needles, tacks, hairpins, coins, fruit seeds, false teeth, screws, pokers, nails, small bones, and spicules of large bones are among the offending substances. The resulting harm depends chiefly upon the size, shape and nature of the object, and the length of time it is retained.

As to the time element, reports vary from overnight to from four to nine months. The length of time required for an object to pass from the alimentary canal to the sigmoid or rectum varies with the individual; then there is the somewhat rare possibility of its passing backward and forward throughout the intestinal system. Akers[1] details a case in which the patient complained of a frequent urge for defecation, efforts toward which were ineffective owing to the sharp, pricking pains to which they gave rise. These pains varied in intensity according to the hardness of the stool. This condition, he stated, had been present over a period of thirty years. It had been diagnosed as hemorrhoids or fissure, and treated with soothing unguents without benefit. Upon local examination, Akers found a long, bent pin, embedded in the tissues just above the internal sphincter and extending downward and backward almost to the skin, the head reaching across the anal orifice. Thus, whenever the fecal mass passed over this, it carried the point downward and backward, producing a scratching, pricking pain. Smith[10] relates a case in which a darning needle had been retained by a woman for about 16 years and was finally removed through the anus. Both these instances, however, are extraordinary.

Foreign Bodies Formed Within the Intestinal Tract

These are of two general types: concretions composed of chemical substances which the system cannot absorb; and those composed of vegetable matter, undigested food, inspissated mucus, etc. The first type depends upon the individual, his habits, diet, temperament and place of residence. Those who are accustomed to taking large quantities of medications such as bicarbonate of soda, magnesium, salol, calcium and other such drugs are liable to the formation of these chemical masses, or concretions; also those who live in limestone regions and use hard water and those whose intestinal secretions are deficient and whose intestinal contents are habitually hard and dry. The second type are enteroliths or colproliths, according to whether they form in the small or large bowel. These form around a nucleus, which may be hardened vegetable matter, gallstones or small chemical concretions, hardened fecal material (fecaliths), or a true foreign body such as a cherry stone. They usually have a hard chemical covering over a softer inner mass. These bodies may form anywhere along the intestinal canal, become detached from their point of origin and move along until they are arrested in the curve of the sigmoid flexure, the valves of Houston or the crypts of Morgagni. The products of ectopic gestation may undergo calcification or mummification and be expelled through the anus, perhaps years later.

Foreign Bodies from a Neighboring Viscus

Luders mentions a patient with a pessary which ruptured into the bowel from the uterus. Purulent collections in the female pelvic organs, notably as a result of either spontaneous or induced abortion, sometimes rupture into the bowel. Occasionally a prostate or appendiceal suppuration may behave in a similar manner. Chavannaz[5] gives details of six examples of salpingitis which opened into the rectum. Gallstones are probably the most frequent. Robillard, Goldman and Osterhus[13] reported a case in which a long pin was found between the rectum and bladder. The patient complained of low back pain. Proctoscopic examination revealed several ulcers on the anterior rectal wall near the level of the peritoneal reflection. The pin was removed at laparotomy.

CHAPTER 24

Foreign Bodies in the Rectum

Medical literature is prolific on the subject of foreign bodies in the intestinal system, their number and variety being almost incredible to any but the well-accustomed, trained mind of the physician. The most likely site for arrest and retention of these objects is the rectum or the sigmoid flexure, owing to the conformation peculiar to these organs. Small objects, such as pins, tacks or splinters of bone, are prone to lodge in a crypt of Morgagni. The history of their passage to these sites, however, and of their removal therefrom, covers many diverse phases and possibilities.

There are four routes by which a foreign body may reach the rectum: first, by ingestion and passage through the alimentary canal; second, through development within the intestinal tract; third, by traveling from a neighboring organ; fourth, by introduction through the anus.

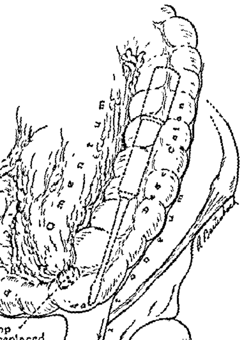
ROUTES OF ENTRY

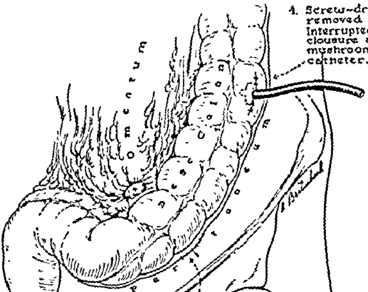
Foreign Bodies Ingested

This is usually accidental, but may, on occasion, be deliberate, as for instance, with suicidal intent, for bravado, or professionally (as in circus side shows) or for concealment. There are also the more rare examples of gluttons, who eat so fast or wish to eat so much that they swallow some substances whole, as snails, plums, cherries, etc.; and the toothless, who cannot masticate, yet cannot resist some favorite tidbit. Hazelhurst[7] reports a case in which 280 plum stones were removed from a colored man who had swallowed about a peck of whole plums.

Except among the insane, however, foreign bodies are usually swallowed accidentally, and sometimes unconsciously. It is the latter cases that are likely to be most troublesome, because the patient does not seek medical aid until driven to do so by pain or other symptoms, and even then cannot aid the physician in diagnosis because he is ignorant of the act which is the cause of his distress; moreover, such patients are usually children, who are the victims of their natural thoughtlessness. Under this heading, also, may be included such objects as are overlooked or forgotten because of their commonplaceness, for example, the harsh outer hull of apple seeds, the seed itself or grape seeds. Hair balls, too, may be considered in this class. Allingham[2] related a history of intestinal obstruction extending over several months, in which a large mass was removed, the center being composed of hair which had been swallowed.

As to objects swallowed consciously but accidentally, Goodsall observed that these occur mostly in patients over 35, although


Omentum


4. Screw-driver removed
Interrupted clousure around mushroom catheter.
Omentum

Foreign Bodies Introduced Through the Anus

The accidental passage of a foreign body into the rectum through the anus results usually from impalement or from therapeutic mishap. The latter may feature enema tips or any type of syringe nozzle, rectal thermometers and dilators. Rosser[14] cites a woman who was seen two hours after she missed the tip from the enema tube. It was located by roentgenogram and subsequently removed through the anoscope without difficulty. He[15] also mentions a child who was permitted to hold the rectal thermometer without supervision. It was



Fig. 655. Bottle in rectosigmoid removed after twelve hours. (Curtice Rosser.)



Fig. 656. Nine-inch case knife removed from the sigmoid colon via rectum. The blunt end was pointed cephalad. (Vaughan and Martin: J. A. M. A. 130:29.)

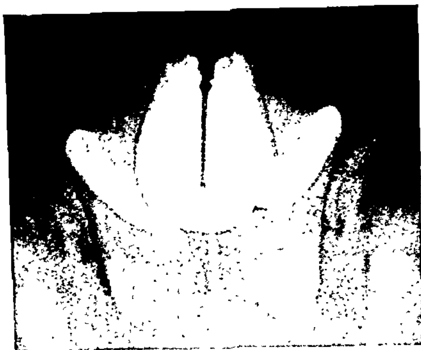


Fig. 660. Electric light bulb tightly impacted in lower sigmoid. (Curtice Rosser.)

mus, diarrhea, sweats, fainting, convulsions and other more or less serious manifestations may occur, any or all of which may be misleading in the absence of a definite history, unless careful local examination is made. Correct diagnosis is especially liable to be hindered where the patient cannot or will not give a true history. The objective symptoms are scarcely more definite, except where the foreign body produces a bulge that may be seen or felt. The physical symptoms may be a moist condition of the anus, slight discharge of pus, protrusion of hemorrhoids, and sometimes prolapse of the mucous membrane, but none of these is distinctive for this condition. Bazy,[3] for instance, noted a patient who inserted a drinking glass which produced neither pain nor any other symptom except a feeling of weight.

As a rule, pain is continuous if the object is sharp and the mucous membrane torn. If it be rounded but caught in a crypt, the pain may be constant or may occur only during defecation. Lodgment of fecal particles may cause pain at defecation and for



Fig. 661. Fecalith in a patient with congenital absence of rectum. (L. Hirschman: Tr. Am. Proct. Soc. 41:141.)

missed two hours later, located in the sigmoid and removed with dressing forceps. The former group includes *iron spikes, large* slivers of wood, stakes, hammer handles, canes, curtain rods, etc. The objects inserted intentionally are legion: bottles, jars, sticks, pipes, corncobs, penholders, glasses, silverware, pots, potatoes, apples, lemons, and so on through a wide and extraordinary variety. (Figs. 655, 659, 660.) The reasons for such insertion are varied.



Fig. 659. Roentgenogram of an 8-ounce tumbler inserted because of marked bleeding from the rectum. (J. C. Burns.)

Rosser cites an electric light bulb; Wyker mentions a lemon wedged in a cold cream jar; Thorek[17] reports an 8-inch screw driver (Figs. 657, 658); the author at one time removed a wax candle from a rectum. In the early ages this was a common method of torture or even death. Today patients offer many explanations: to relieve constipation, to stop diarrhea, to reduce a prolapse, to cure hemorrhoids, to limit the amount of food needed by limiting the amount of excretion, to relieve bladder retention, and so forth. Sometimes a bottle is used as a means of injecting medicinal fluid of some sort into the rectum and escapes from the patient's grasp. Then there *is the less legitimate urge of auto-eroticism.* Possibly the greater number of cases are the result of this type of sexual depravity, and the patient's reluctance to seek aid until the condition is far advanced often leads to a fatal termination.

SYMPTOMS

The symptoms are extremely variable and often are not related to the true cause of distress. They depend largely on the size and shape of the object, the amount of damage done and the rapidity with which tissue destruction takes place. Pain may occur within a few hours and be almost continuous. On the other hand, the first symptoms noted may be such as to lead to a widely different diagnosis. Pennington[11] noted an instance of an insane person who swallowed nails with no manifestations whatever except the blackish color of the stools from the iron. Conversely, bleeding, colic, nausea, vomiting, hiccoughs, tenes-

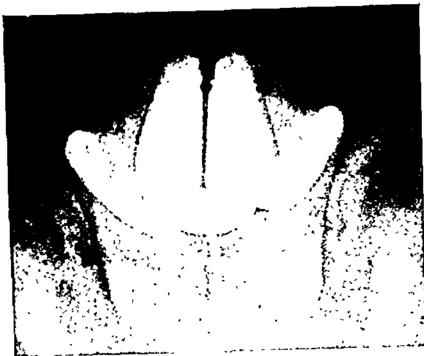


Fig. 660. Electric light bulb tightly impacted in lower sigmoid. (Curtice Rosser.)

mus, diarrhea, sweats, fainting, convulsions and other more or less serious manifestations may occur, any or all of which may be misleading in the absence of a definite history, unless careful local examination is made. Correct diagnosis is especially liable to be hindered where the patient cannot or will not give a true history. The objective symptoms are scarcely more definite, except where the foreign body produces a bulge that may be seen or felt. The physical symptoms may be a moist condition of the anus, slight discharge of pus, protrusion of hemorrhoids, and sometimes prolapse of the mucous membrane, but none of these is distinctive for this condition. Bazy,[3] for instance, noted a patient who inserted a drinking glass which produced neither pain nor any other symptom except a feeling of weight.

As a rule, pain is continuous if the object is sharp and the mucous membrane torn. If it be rounded but caught in a crypt, the pain may be constant or may occur only during defecation. Lodgment of fecal particles may cause pain at defecation and for



Fig. 661. Fecalith in a patient with congenital absence of rectum. (L. Hirschman: Tr. Am. Proct. Soc. 41:141.)

several hours thereafter. Large, rounded, or smooth objects usually produce a dull, heavy pain. Any object within the grasp of the sphincter muscles causes intense suffering.

DIAGNOSIS

Owing to the vague and complicated symptomatology, the only reliable means of diagnosis is local examination, using the finger or the proctoscope. It has been recorded that a rubber catheter looped around a stone inserted in the rectum was sufficient to draw it completely out. Similarly a wire écraseur may, at times, be all that is needed. Where the body is arrested in one of the crypts of Morgagni, the fenestrated speculum used in connection with a laryngeal mirror is of great value. Where it is arrested above a stricture or a hypertrophied valve of Houston, a bent probe or searcher may be required. Fluoroscopic examination or a roentgenogram is of utmost value when the foreign body is located in the upper rectum and sigmoid colon. Depending, of course, on the character of the object, it often gives a fair idea of the size, shape, position and general state of roughness of the object.

Dangers

In making digital or instrumental examination, skill, gentleness and judgment must be exerted since carelessness or too great pressure may result in rupture of the bowel or in breaking the object or pushing it higher into the intestine.

COMPLICATIONS AND SEQUELAE

Trauma, abscess, fistulae, perforation and peritonitis are some of the attendant dangers or sequelae, besides urinary disturbances, affection of the testicle and ulcerations. These may be caused by the object itself or by efforts to remove it.

PROGNOSIS

The prognosis in extra-abdominal cases is nearly always highly favorable, although due consideration must be given the possibility of shock, severe hemorrhage and peritonitis. Where objects reach the pelvic portion of the rectum, however, or where they are too firmly wedged to be dislodged by traction, laparotomy may become necessary. Van Hook,[18] in a series of 58 cases, had a mortality of 34.5 per cent; yet there were no fatalities in a series of 30 cases where the injury remained extraperitoneal.

TREATMENT

It is possible that spontaneous expulsion may take place even after the body has remained in the rectum for some time. Such a result is especially to be hoped for when the object is small and fairly smooth or even rounded. The ingestion of large quantities of soft bulky foods, such as potatoes, oatmeal, buckwheat cakes or bread pudding, is advised. Potato may remove even powdered glass. This diet should be followed by a laxative. Strong cathartics are to be avoided, as any violent movement of the object may drive it into the wall of the rectum or cause abrasion of the surface. Da Costa[6] suggested that the patient be fed nothing but bread and milk, in order to put a smooth coating on the object, this to be followed by a mild laxative. Failing expulsion, the large majority of objects will yield to instrumentation or manipulation.

Instrumental Removal

Soft Bodies, such as potatoes and apples, can be lifted out after boring a hole through them to overcome suction. Smaller objects that are solid and roundish in shape may sometimes be grasped by forceps and drawn out. Care must always be taken not to injure the rectal surface. Where the body is of a soft substance, such as wood, it may be grasped by forceps, or a gimlet or screw may be used to assist in its removal.

Small Objects. Soft metal, such as hairpins, safety pins, nails, etc., may be cut with forceps and removed piecemeal. Metal objects may also, at times, be removed by

magnets. Agglomerations, also, can usually be broken off in small pieces by forceps and removed a piece at a time. Kotzareff[8] and Mauclaire[9] each reports a case in which many hundreds of cherry pits were removed. Benhamou[1] removed a fecaloma by dilating the anus under anesthesia and breaking up the mass with a curette. In the case of small, hard, round objects, such as stones, which are difficult to grasp, a small placental forceps may be effective. A lithotomy forceps is often a material aid. Retractors may be employed as guides, while pressure is exerted above the object.

Brittle or Large Objects. In dealing with hard or brittle substances, such as glass, steel or stone, it is usually necessary, because of the difficulty of grasping the object, to anesthetize the patient and dilate the sphincter, proceeding then to removal in the most facile way. At times the hand can be inserted; many instances are recorded in which small boys were pressed into service and persuaded to insert a hand into the patient's rectum and grasp the foreign body. If the object is glass and is broken or must be broken to effect removal, gauze should be inserted between it and the rectal wall if at all possible. In removing unbroken objects of glass or other smooth, slippery material, it has been found useful to wrap the forceps blades in gauze or rubber to prevent slipping. By this method Pruitt[12] removed a full-sized ginger-ale bottle from the rectum of an aged Negro who stated that it had been inserted as a joke. More rarely the swallowing of cotton batting has been advocated, but this is usually in cases where spontaneous expulsion may be hoped for. Where a glass, china or stone object, such as a glass, a vase or a jar, is inserted with the open end down, Le Fort advocates filling it with plaster of paris, leaving an end protruding for traction, and pulling it down by this improvised handle. Where the open end is upward, Neale[10] suggests boring a hole in the bottom, inserting the finger, and pulling downward. When the rectum has prolapsed into the aperture, owing to straining or tenesmus, the difficulty is not only to remove the body, but to do so without injury to the gut. In all these instances, where the object may be removed through the anus, a quick and complete cure ordinarily results. It must be remembered, however, that objects are generally inserted with the small end first, and must therefore be withdrawn with the large end first. This entails much skill, care and ingenuity. Care should be taken always to cut rather than overdilate or tear the sphincter.

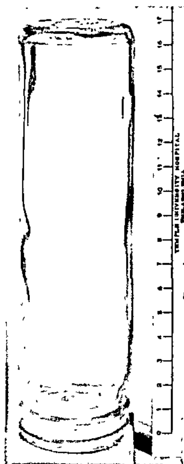


FIG. 662. Olive bottle removed from the rectum. (J. S. Deakins, Temple University and Hospital.)

When the anus is too small to permit passage of the object, the rectum must be split

backward to the coccyx and upward through the internal sphincter. When large bodies have been driven into the sigmoid flexure, colotomy is necessary. The abdominal cavity should be opened, a longitudinal incision made in the gut and the object removed. Sigmoidostomy or colostomy may be necessary where perforation has occurred distally. (See Treatment, Chap. 23, Wounds, etc.)

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CHAPTER 25

Tumors, Cysts and Sinuses of the Sacrococcygeal Region

Affections in this locality not only offer a fascinating field of study, but are of unusual interest because much confusion surrounds their etiology, and their treatment is so often unsatisfactory. Therefore, in order to understand more clearly the formation of various congenital defects in the sacrococcygeal region, a brief review of the embryology seems expedient.

DESCRIPTIVE EMBRYOLOGY

Explanation of Various Tumors, Cysts, Sinuses and Dimples Usually Occurring Posterior to the Sacrum and Coccyx. As will be recalled, the neural plate, or lamina medullaris, which serves to form the neural groove, is derived from the ectoderm.[4] By a process of curling, the cells forming the borders of this groove shape themselves to construct a canal known as the medullary, or neural, tube. During this development, a part of the primitive streak is included. From the primitive intestine, the notochordal canal and the neural plate, is formed the neurenteric canal, communicating with both the neural groove and the hindgut in its posterior aspect. Normally, prior to the fourth week of embryonic life, the neurenteric canal becomes obliterated, but to its persistence has been attributed the development of brainlike structures in this region.[72] MacGrath[106] stated, in part: "... other authors postulate vestigial neural canal remains; others state invagination and inclusion of surface epithelium during the first three or four months of embryonic life to be the causative factor . . ."

Kooistra, in a study of 40 human embryos, found a remnant of the neurogenic medullary canal overlying the coccyx in each one of them. In some embryos, he found defects in the surface epithelium with marked irregularity, some showing actual invagination to form deep dimples, agreeing with Fox's theory. Bunch[31, 170] supported this invagination theory, concluding that it took place between the third and fourth month from cells destined to form hair and glands; most authors concede that it is due to invagination of the ectodermal layer.

Ferguson and Mecray[57] offer arguments against the "neural rest theory," among them being the following: (1) a general absence of nerve tissue in pathologic sections from pilonidal cysts; (2) universal presence of squamous epithelium as a cyst lining; and (3) absence of any dermoid structures other than hair and sebaceous material.

The presence of a caudal appendage which is analogous to that in embryos of other mammifera has been described as existing at the third week; this disappears later.[46, 73] Until the eighth week, the medullary tube or future spinal cord extends to the tip of the vertebral column, where it is bent backward and is adherent to the deeper layers of the skin. By the twelfth week,

because the vertebral column develops with greater rapidity than the medullary tube, a considerable inequality exists, so that a portion of the medullary tube which adjoins the vertebra is drawn upward. The distal atrophies and disappears about the fourth month, but the caudal, or reflected, portion continues its evolution and becomes converted into tubular masses termed "coccygeal vestiges of the medullary tube."[153]

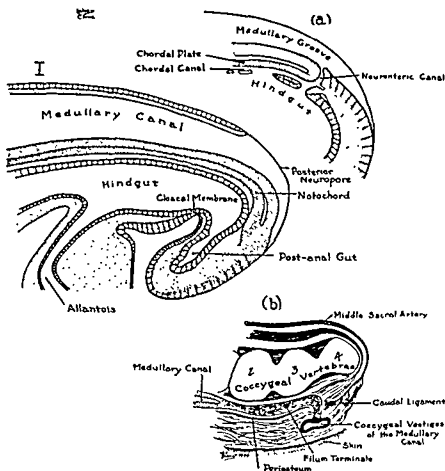


FIG. 663. I Median section through the caudal end of Eternod's embryo with eight pairs of somites. (a) Median section through the caudal end of Bremer's 4-mm. embryo. (b) Schematic median section through caudal end of a human fetus 11 cm. long. (After Unger and Brugsch.) Note that the anus will be formed by absorption of cloacal membrane anterior to the distal end of gut, leaving the "postanal gut" to become obliterated. In an earlier embryo (a) is shown position of the neurenteric canal. Note in (b) vestiges of the distal end of the medullary canal left near the tip of the coccyx, and "caudal ligament." (After Keibel and Mall.) (F. H. Lahey, and E. B. Eckerson: Am. J. Surg. 23:31.)

portion, which is still continuous with the rest of the medullary tube and adherent to the skin, is placed on a stretch. This then becomes divided into a direct coccygeal segment and a reflected, or caudal, segment. Ordinarily, the direct coccygeal segment These tubular structures, or vestiges, are lined by a layer of columnar or polyhedral cells and are attached to the coccyx by a bundle of laminated fibers referred to as the caudal ligament. The maximum development is attained by the fifth month, but

thereafter the vestiges undergo progressive atrophy.[109] Remnants of these vestiges may give rise to dermoid cysts, sinuses or mixed tumors, usually situated posterior to the coccyx, although their position may be in the perineal region or between the sacrum and the rectum.[42, 49] The bundles of laminated fibers constituting the caudal ligament radiate to the skin overlying the tip of the coccyx[22] and, since the growth of the caudal vertebra is more rapid than that of the soft parts and skin, the latter are displaced upward, during which process the skin to which the ligament is attached becomes invaginated and forms an infundibular depression termed "sacrococcygeal dimple," or pilonidal sinus. According to Mallory,[110] closure of this sinus at its external opening results in a dermoid cyst.

A perusal of the literature relevant to embryology brings to light controversy about the correctness of the term "pilonidal." MacGrath[106] flatly states that it is a misnomer, is misleading and definitely inadequate and that "misleading surgical information is bound to be fostered by the persistence in continued use of these terms and the present method of reporting operative statistics and postoperative results; also the present generalized grouping of all varying degrees of these pathologic entities permits of no differentiation as to character, degree, or extent."

Explanation of Various Tumors and Cysts Usually Occurring Anterior to the Sacrum and Coccyx. The caudal end of the hindgut which is connected to the neurenteric canal enlarges, about the third week of embryonic life, to form the cloaca, or rudimentary rectum. (Fig. 663.)

Communication between the proctodeum and cloaca is established during the eighth week, owing to absorption of the cloacal membrane. According to Ewing,[51] dermoids may develop because remnants resulting from faulty fusion and absorption of this cloacal membrane persist. He cites others[111, 118] who collected a variety of cysts derived therefrom. At or about the same time that communication occurs between the proctodeum and cloaca, or anus and rectum, the portion of the gut below and posterior to this point of exit becomes obliterated. If, however, this distal or subcaudal portion persists, this vestige may give rise to new growths, commonly designated as "postanal gut tumors." Such are usually presacral and include dermoids and teratomas.[93, 119]

CLASSIFICATION

For the purpose of clarity, the various congenital tumors, cysts and sinuses of the sacrococcygeal region may be classified as follows:

Tumor	Embryologic Derivation
A. Pilonidal Sinus and Cyst . Postsacral Dermoid	ectoderm
B. Dermoid Cyst .. Presacral	ectoderm
C. Teratoma	ectoderm mesoderm (one or all) entoderm
D. Chordoma	mesenchyme

PILONIDAL SINUS AND CYST

Definition

Pilonidal sinus is a congenital defect resulting, most probably, from faulty coalescence or invagination of the skin ectoderm in the midline over the sacrococcygeal region during early embryonic development, characterized by the formation of a tract in which are collected the products of dermal activity, with a tendency to burrow and undergo abscess formation. These gain exit through the original site of invagination or through aberrant tracts, manifesting itself after puberty, usually following some exciting cause.

Synonyms. Pilonidal,[103] or pilous, cyst;[103] postanal, sacrococcygeal, coccygeal dimple, sinus[15, 57] or fistula;[120] sequestration,[9] coccygeal,[8] postsacral,[37] traction[130] dermoid; foveola coccygea, jeep disease.[31]

It is common knowledge that the terms "sinus" and "fistula" are not synonymous. Smith and Nesselrod[129] state that failure to

make this distinction is responsible for considerable confusion relative to pathologic processes in which both of them are formed. To obviate this, the latter designated all openings in the anal and perianal skin, the perineal skin and sacrococcygeal regions from which there exudes any type of discharge, "draining sinuses." In this connection, proof must needs be presented that a given draining sinus is actually such or one opening of a true fistula, according to the premises stated above.

Incidence

The sacrococcygeal dimple is frequently encountered at all ages and in both sexes. Pilonidal or sacrococcygeal sinus is comparatively common in young adults, especially the male when hypertrichitic. They have been reported in twins. Fox[50] reported identical twins, both females, age 19. This occurrence is quite infrequent, however, in identical twins, as reference to but two such occurrences has been made in the literature. In one family of five brothers and two sisters, all but one girl had pilonidal cysts; two of the male siblings were twins, all were stout, and one of the females had a sinus exhibiting extensive hirsutism.[83]

Several years ago the writer[6] collected a series of 240 cases of pilonidal sinus from the Proctologic Departments of Temple University and Graduate Hospitals. To 1938, the number from the two clinics totaled 414. Aside from this group, there have been 304 private cases, which, in comparison with the various reports during World War II, is extremely small. In discussing the incidence according to age and sex, one group of 268 patients is recorded as follows:

Age	Number of Cases
16-20	36
21-30	168
31-40	52
41-50	12
Total	268

For age incidence, primary manifestations usually appear in either early or late adolescence due to the increased endocrine activity present at this period.[85, 155, 162]

Sex	Number of Cases
Males	201
Females	67
Total	268

It may be of interest to mention that two cases of pilonidal sinus occurred in young infants. These have been reported recently, one at 5½ months by Kleckner,[89] the other at 17 months by Muller.[123]

Race. This congenital defect seems to be peculiar to the Caucasian race. The author has encountered only five Negro cases, although several instances have been reported.[6, 17, 47, 71, 148, 171] (Fig. 664.) In Kleckner's series of 160 cases, 67 per cent were brunettes and 33 per cent blondes.

For the white race, the condition is predominant in males in the ratio of about 3 to 1. Among Negroes, the conditions are reversed, for colored women have the entity more commonly than men, according to existing statistics.[52, 85]

Etiologic Hypotheses

One of the earliest theories is that of Warren,[165] who believed that pilonidal sinus was due to reversion in the polarity of growth of the hair follicles.[170] Hodges,[71] however, felt that it was caused by faulty coalescence of the lateral halves of the body and that the dimple was filled in by hair rubbed off the body. From the latter idea was formulated what is known as the theory of ectodermal invagination, which, as promulgated by Lannelongue,[95] is that these sacrococcygeal cysts and sinuses result from an extension inward of the skin which is bound down to the coccyx.[146] To quote, "The mesoblast lies, after the formation of the medullary canal, between the external epidermis and the vertebral column, except in the region of the sacrum, where little of this tissue is interposed, so that this region

is reduced to epidermis and bone. Consequently, the superficial layer, the epiblast, joined at a later period to the mesoblast, preserves closer relation with the bone, and later, when the subcutaneous tissue is developed around these places, a depression will be formed." Bland-Sutton[9] believes that these sinuses are true sequestration dermoids, being formed as a result of inclusion of normal epithelium because of faulty coalescence in embryonic life. Aschoff[1] describes the condition as caused by improper median skin agglutination of the sacrococcygeal region. Oehlecker[131] advances the theory that, as a result of traction by the caudal ligament which is the connective tissue prolongation of the caudal vertebra on the thin, hairless skin of the sacrococcygeal region, invagination of the margins of the surrounding skin containing hair follicles occurs, so that with the downgrowth of the vertebral column the skin is displaced upward and posteriorly. In this way the normal products of skin metabolism readily accumulate to form cysts or discharge intermittently as fistulae. Newell[130] concurs in this view and describes it as being caused by traction of the underlying tissue upon the median bud, which is brought about by retrogression of the tail bud. He therefore suggests the term "traction dermoid."

Along a similar line of reasoning is the concept of Bookman,[20] who seems convinced that dermal or dermoid cells are displaced during embryonic life and remain dormant, but while fusion takes place in the midline, these cells assume an abnormal location under the skin which, with the accumulation of the products of skin metabolism, later forms a cyst. Dulligan[44] is of the opinion that a pilonidal cyst is simply the result of ectodermal invagination together with traumatism.[4, 28, 130, 135] Stone[151] is quite emphatic in his belief that a persistence of the medullary remnants plays no part in the formation of pilonidal sinus, and remarks, "the coccygeal medullary vestige, which has no communication with the skin, consists of cells which have become so differentiated that they could not be expected to give rise to skin even though a cystic remnant should persist . . . and that pilonidal sinus is due to a special local downgrowth of epithelium originating from true skin and not from the medullary groove."



Fig. 664. Pilonidal cyst with abscess formation in a colored girl, age 24.

The neurogenic theory, conversely, as propounded originally by Tourneaux and Herrmann,[158] assumed that these congenital sacrococcygeal cysts and sinuses resulted from a persistence of the coccygeal vestige of the neural canal. This was substantiated by the investigations of Mallory,[109] who made microtome sections serially through the sacrum and the coccyx of several human embryos. He demonstrated rather consistently a tubular structure lined with cuboidal or columnar epithelium connecting the skin and concluded that failure of these medullary vestiges to disappear gave rise to congenital dimples, sinuses and cysts found in the midline of the sacrococcygeal region.

Shenkin, Hunt and Horn[146] reported a case that seemed to substantiate the theory of persistence of coccygeal vestiges of the neural canal, and, in support of their contention, embryologic study has presented the fact that the caudal end of the neural canal is pinched off quite early in the embryonic stage, and an epithelial sac communicating with the skin in the sacrococcygeal area is produced. Just proximal to this, the neural sac atrophies, disappearing about the fifth uterine month; it is this

sac's persistence that causes sacrococcygeal sinus. In their case, the anatomic findings demonstrated a dermal sinus, presenting in a sacrococcygeal dimple, to be in direct continuity with the central canal of the spinal cord, a concrete example of the relationship of sacrococcygeal dermal sinuses with abnormalities in development of the neural canal. The presence of an intramedullary abscess of the spinal cord and a purulent meningitis by contamination through the dermal sinus, indicated the importance of early excision of such congenital lesions.

Féré[71] also considers this theory to be the proper explanation. Anderson[3] describes this process by stating: "When atrophy fails to take place, a pilonidal sinus may develop . . . if included ectoderm is completely surrounded, it is termed a cyst; if partially so, a sinus."

Returning to the neurogenic theory, this fails, however, to explain the presence of hairs, found in approximately 50 per cent of all cysts and sinuses.[170] Another theory elaborating on the Tourneaux-Herrmann theory was given in a dissertation by Wendelstadt at Bonn. He maintained that in the development of the neural canal, its threadlike tip is left attached to the skin at its caudal end and, as the fetus develops, the spine grows more rapidly than the skin, pulling the attached end superiorly and posteriorly so that it describes a "U" around the coccyx.

Terrillon[154] suggested that it was a special form of spina bifida, and another theory suggests that it might be the vestiges of a posterior umbilicus. Tait[152] described it as a cicatrix of the spina bifida. Both Moise[121] and Ripley[140] consider pilonidal sinus to be analogous to spina bifida and report two cases in which a direct communication existed between the sacral sinus and the spinal meninges. Improper development of the vertebrae was associated. Glenn, in 1932, reported only two cases of spina bifida occulta in a series of 19. MacFee[105] reported one case which was incomplete in type. Nasse[127] believed that the persistence of the remnants of the neurenteric canal is an important etiologic factor, which theory is supported by another.[111] Gage[63] postulated that pilonidal sinus resulted from an anomalous development of the medullary canal and that coccygeal dimple resulted from disturbances in development of the coccygeal ligament and was not connected with the medullary canal.[140]

Rosser[143] expressed the opinion that dysfunction of the pituitary plays an important role, inasmuch as many of these cases occur in large and peculiarly developed overweight boys. Kallett and Moehlig[85] noted the body build in 18 males who were of the pituitary type. The shortest in the group was 5 feet 7 inches; five were 6 feet, or over, and seven were over 5 feet 10 inches. Ten of them weighed from 190 to 238 pounds.

Weeder[166] advanced the opinion that most cases of pilonidal sinus, cyst, dermoid or dimple that recur following block dissection are the result of an unobliterated portion of the medullary canal, and that this portion will be below the last segment of the sacrum and usually at the sacrococcygeal articulation.

The "preen gland" theory, comparatively recent, is of unusual interest. Impressed with the work of various investigators, Stone[150] conceived the close analogy between this gland in birds and pilonidal sinus. This was also shown to be somewhat similar by others.[4, 31, 57, 83] He mentions that a great many species of birds possess a preen, or oil gland, which, according to Lunghetti,[102] serves as a special scent gland concerned with protection and sexual attraction. This preen, or uropygial, gland lies in the region of the last caudal vertebra in the subcutaneous fat and consists of a number of straight tubules lined by polyhedral cells which empty into a single, small cavity communicating with the skin surface through an epithelial-lined duct. In the mouth of this duct is found a small tuft of

hairlike feathers. He mentions that the direction of the duct is cephalad, which is analogous to the upward and backward direction of the pilonidal sinus in humans. According to Paris,[134] these glands are usually located close to the skin in the anal or caudal region. In describing the resemblance between the preen gland and pilonidal sinus, Stone remarks as follows: "It may be said that, in many species of animals, the skin about the sacrococcygeal and anal region possesses the power of developing glandular structures strongly suggestive of a relationship to pilonidal sinus. It may be assumed that in certain individuals of the human species the latent potentiality, for some reason, develops into an actuality and results in the structure known clinically as pilonidal sinus."



FIG. 665. (*Left*) Pilonidal sinus and cyst. Sagittal section showing (A) primary tract leading from cyst cavity to external skin surface. (B) Represents secondary tract.

FIG. 666. (*Right*) Photomicrograph of pilonidal cyst, low power, showing the cyst cavity surrounded by granulation tissue and lined with epithelium.

MacGrath[106] calls attention to the fact that similar structural defects are found also in other portions of the body, far removed from this area, where the pathologic presentation is fundamentally the same as in the sacrococcygeal region. He reported a case of manubrium sterni involvement in a female.

In a very elaborate restudy of the sacrococcygeal region following histologic investigation of human embryos, Fox[60] concluded that "its mode of origin and the analogy drawn between this structure and the special 'scent' gland in the sacrococcygeal region of birds and amniotes suggested the probability that the sinus represents a vestigial skin appendage developing at puberty—hence the age distribution of pilonidal sinus."

Pathology

Whereas a sacrococcygeal dimple is present as a small depression or conical pit, a pilonidal or sacrococcygeal sinus in its uncomplicated form occurs as a small aperture of barely sufficient size to admit the tip of a probe.[104] The orifice is oval or round in

shape and smooth, composed of skin. A small tuft of hair projecting from the opening is often present.[2]

Either the dimple or the opening of the sinus may be located over the tip of the coccyx, the lower sacrum or the sacrococcygeal articulation. The latter is the most frequent site.[31, 111] Ordinarily the single sinus extends upward toward the sacrum under the surface of the skin in the subcutaneous fatty tissue and ends blindly—frequently in a pouch or cyst cavity. (Fig. 665.) McCutcheon[104] stressed the point that a sinus is a disease of the subcutaneous fat and not the skin, and there are usually, but not often, dimples of small size in the sacrococcygeal region, forming the sole connection with the skin except where artificial ones are made by surgical incision or spontaneous rupture of an abscess. They possess no surgical significance, per se, but are important only if they connect with the epithelial-lined tract in the subcutaneous fat, a fact that is overlooked in most pathologic discussions.

Seldom do these sinuses invade the sacrococcygeal hiatus; at least this was our experience as determined by the injection of lipiodol prior to x-ray treatment.[6] Probably enhanced by the collection of sebaceous material and detritus in the small depression, infection may take place following trauma, and present signs of inflammation such as redness, swelling, induration and tenderness. Where suppuration has occurred, two, three or more tracts may develop, which are usually situated lateral to the midline of the body. These adventitious tracts, which are quite devoid of a cutaneous lining, are ordinary sinuses presenting granulations, the orifices of which are ragged and ulcerated. The material exuding or expressed from the sinuses is purulent, slight in amount and tends to cause additional irritation of the skin surrounding the orifice. Occasionally a mat of loose hair mixed with macerated epithelium and pus may be extracted with the tip of the probe following its withdrawal.

Rogers and Hall,[2, 4, 112, 155] in studying the morphologic characteristics of pilonidal sinus, classified the tracts as follows:

	Number	
1. *Midline Tracts*		
a. with a single opening	11	
b. with two separate openings ...	8	
c. with multiple openings	7	
d. dimples	5	31
2. *Tracts* extending laterally from midline		
a. with a single midline opening ..	1	
b. with midline openings and one lateral opening	5	
c. with a midline opening and multiple lateral openings	1	7
3. *Unclassified Tracts*		
a. "recurrent"	3	
b. of undetermined structure	3	6
Total		44

Histopathology

The wall of the dimple shows a cutaneous covering with sudoriferous glands in abundance. The sinus is lined by stratified squamous epithelium with slight cornification. (Fig. 666.) The corium beneath is dense and thick, surrounded by adipose and areolar tissue. The cyst cavity is smooth and glistening, while attenuated hair follicles and sweat glands are usually present.[155, 170] The surface of the cavity is lined by stratified cuboídal epithelium. Round-cell infiltration of both plasma and wandering cells are likewise present, outside of which are several layers of fibrous tissue surrounded by fat. Both the sinus and the cyst cavity usually contain a few strands or even a flock of loose hair. However, in a review of the sections made from all specimens removed at the Graduate Hospital of the University of Pennsylvania (1936), there was shown but one case in which hair follicles and sweat glands were observed in the depth of a sinus.[57]

While it is commonly accepted that hair found in pilonidal sinuses and cysts grows from the epithelial lining, Granet and Ferguson[67] refute this, as they never found hair in a solitary pilonidal cyst. They found hair only whe[illegible]municated with

an adjacent sinus, in sinuses and also in deep dimples; they have yet to see undoubted evidence of hair follicles in sections taken through the wall of excised pilonidal cysts. In MacGrath's series of 132 cases,[106] he found but four instances, or slightly over 3 per cent, of them containing hair.

Symptoms

Under ordinary circumstances, a pilonidal sinus or cyst causes no symptoms unless in the presence of infection, in which event the complaints are usually those of recurrent abscess formation following an exciting cause. Most frequently, the patient will cite some form of irritation or trauma to the sacrococcygeal region, such as sitting, riding or falling.[8, 28, 57]

One learns from the history that this was followed by soreness and a sensation of moisture, but usually the presence of a discharge which irritates the surrounding skin and stains the underclothing is described.[57] The entire train of symptoms may have subsided only to recur two or more times. Not infrequently, mention is made of one or more incisions or a similar number of operations without permanent cure.[10, 11] If the condition is at all severe, the symptoms are intensified by sitting and lying, in which case the patient is miserable. Constitutional disturbances, such as chills, pyrexia, cephalalgia and general malaise are not uncommon.

Diagnosis

The diagnosis of pilonidal sinus is made on the presence of a small opening in the dorsal midline over the sacrococcygeal region, into which a probe may be introduced for a varying distance. (Figs. 667, 668.) Not infrequently, a small tuft of hair may protrude through the aperture which is usually surrounded by an inflammatory areola.[31] The discharge emitting from the sinus is often blood-stained and seropurulent; abscess formation is not uncommon. X-ray examination following the injection of various opaque substances, such as sodium iodide and lipiodol,[15] into the sinus tract has been advocated to determine its extent and course, although in our experience it is of little value and therefore seldom employed.



Fig. 667. Pilonidal cyst and sinus. Photograph of gross specimen showing a pin in the cyst cavity and extending through the sinus to the skin surface.

Differential Diagnosis

Pilonidal sinus is to be distinguished from various affections which may occur in and around the sacrococcygeal region. These are shown in Table 88, on page 932.

Associated Pathology. An unusual case of basal-cell epithelioma associated with pilonidal cyst is reported by Goldman and Kalow.[65]

Treatment

The treatment of pilonidal sinus and cyst deserves serious consideration because delayed healing is only too frequent, and recurrence is not uncommon. Past experience teaches that thorough excision of all diseased tissue, without closure, gives the greatest percentage of permanent cures.

TABLE 88. DIFFERENTIAL DIAGNOSIS

Type	Pilonidal Sinus	Anorectal Fistula	Carbuncle	Osteomyelitis		Actinomycosis
				Tuberculous	*Syphilitic*	
	Congenital	*Acquired*	*Acquired*	*Acquired*	*Acquired*	*Acquired*
Characteristics	Most common in hirsute individuals during early adult life. Dimple or sinus in midline which ends blindly. Hair may protrude from aperture which is usually single	Occurs at any age, usually in adults; closer to anus, although may develop about sacrococcygeal region, in which case they are multiple and lateral to midline. Fistula always communicates with rectum at anorectal line and discharges fecal material and pus. Associated with anorectal symptoms	Inflamed skin and subcutaneous tissue; well circumscribed; suppuration; multiple pin-point openings in summit of lesion	Multiple tract over sacrum, usually outside the midline. Communicates with the vertebrae. X-ray examination confirms this		Extremely rare. Over sacrum is noted a firm swelling of a livid hue; breaks down to form fistulous tracts discharging a seropurulent material mixed with blood and grayish-yellow masses containing the fungus. The apertures of the tracts are uneven and sometimes nodular
				Tubercle bacilli may be found in discharge Purified protein derivative positive. Associated with tuberculosis elsewhere	Wassermann positive; other manifestations of lues	



FIG. 668. Opening of a pilonidal sinus in the midline of the sacrococcygeal region. Note slight dimpling of the skin and the protrusion of a few hairs.

During the past seven years, inclusive of the period prior to, during and following World War II, approximately 1,200 articles have appeared on the subject of pilonidal disease. For the purpose of completeness, some of the more important and newer methods in management are included in the discussion.

Palliative Measures. SCLEROSING AGENTS. Various chemicals in the form of solutions, pastes and powders have been suggested for the treatment of pilonidal sinus. Among these may be mentioned silver nitrate, mercuric chloride,[7] zinc chloride, phenol, chromic acid, nitric acid,[16] arsenical paste and sodium morrhuate.[90]

COMMENT. The author has not employed these agents, but takes the liberty of expressing the thought that, while any form of treatment is welcomed for a condition which in a large percentage of cases reacts unsatisfactorily under any method, this does not seem to be the answer. As Martin well stated,[113] "The amount of pathology present is usually out of all proportion to the external appearance," so that if these sinuses and concealed ramifications are not always found at excision, it is improbable that they can be reached and destroyed by an escharotic.

Roentgen therapy has been recommended, especially in recurrent cases.[149, 150]

Galvanism has been discussed in previous editions but is deleted here since no additional data is available. The interested reader may find recourse to the original article by Maillard.[108] Jacobson[80] advocated electrocoagulation and steam under pressure to define the sinus and branches by insertion of a bipolar electrocoagulator into the sinus, applying the current long enough to produce steam, which, under pressure, penetrates all the passages. The apparatus used is the Kilmer-Jaros, made by the General Electric Company for uterine cervical coagulation. The patients remain ambulant.

Radical Measures. Before discussing the various operative methods, it seems expedient to call attention first to the usual causes of failures following surgical intervention. These may be enumerated as follows: (1) Excision and primary suture in the presence of acute inflammation; (2) incomplete excision of diseased tissue; (3) sepsis; (4) faulty obliteration of dead spaces; (5) imperfect hemostasis; (6) tension on the suture line; (7) use of infiltration analgesia in acute or subacute cases, which tends to spread infection; and (8) trauma.

PREOPERATIVE CARE. Ordinarily the patient is admitted early on the morning of the operative day. A cleansing enema is administered and the sacrococcygeal region shaved widely and prepared with tincture of green soap. As is customary, nembutal gr. i ss, is given by mouth two hours before operation, and morphine sulphate gr. ¼ with scopolamine gr. 1/150, hypodermically three quarters of an hour before operation.

ANESTHESIA. Except in a small percentage of cases where the sinus is small, single and not associated with an acute inflammatory condition, local analgesia should not be chosen. Of course, any of the general anesthetics may be employed, but subarachnoid injection, provided the inflammatory process does not approximate the interspace selected for the puncture, is ideal in these cases. Brockbank and Floyd[23] state that anesthesia is one of the most important points in treatment. Of 47 cases out of 168 done under spinal, hospital stay required 21.1 days; of 116 done under local, the average stay was 46.8 days. No complications occurred under spinal; five occurred with six severe infections under local anesthesia.

INJECTION OF DYES. Various dyes have been employed to demonstrate the sinus and its ramifications, among which may be mentioned India ink, solutions of methylene blue either aqueous or ethereal, gentian violet, and melted paraffin.

Comment. The value of such an injection for outlining the diseased tracts is debatable. Rather than mention the various opinions in regard to this, based for the most part on unscientific deductions, the author

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				Tubercle bacilli may be found in discharge Purified protein derivative positive Associated with tuberculosis elsewhere	Wassermann positive; other manifestations of lues	



FIG. 668. Opening of a pilonidal sinus in the midline of the sacrococcygeal region. Note slight dimpling of the skin and the protrusion of a few hairs.

sue. A brief persual of the number of failures caused by other methods will not leave a shadow of doubt that, for permanency of cure, this is the operation of choice in the vast majority of cases. The only disadvantage offered by this method is the prolonged period of time required for the wound to heal. Mention has been made that the resulting dense scar overlying the bony sacrum frequently gives rise to pain and discomfort. We have observed the latter occasionally, but it has been of no consequence.

Technic. Initially a blunt-pointed probe is inserted into the sinus or sinuses in order to identify the extent and direction. The contaminated instrument is then discarded. An elliptical incision is made, preferably with the electric knife, widely enough to include all existing tracts. The inner edges of the skin island thus formed are held with hemostats and the incision on each side is carried downward and toward the midline to the fascia covering the sacrum. (Figs. 669, 670.) This should be done carefully so that any adventitious tracts extending outside the area may be included in the excision. In cases where the diseased tissue is firmly adherent to the periosteum of the sacrococcygeal region, the periosteum may be stripped, as has been suggested.[36, 167] Seldom will the coccyx necessitate removal. The presence of inflammatory deposits in the subcutaneous fat of the lateral wall is sought by the palpating finger, and should such exist, they are excised. Ligation or electrocoagulation is used to insure perfect hemostasis, thus preventing hematomas, which retard healing.

Comment. Rosser and Kerr,[144] after many years experience, find excision and simple inversion of the skin edges to be the procedure of choice. All wounds were completely healed and without recurrence in a period of 43 days. The same was noted by Berman.[15] Ferguson[55] prefers this method utilizing the cautery. Dunphy and Matson[45] reduced the recurrence rate from 22 to 4.3 per cent by the use of cautery method of excision and open packing in their infected cases. Jacobs,[79] like many others, packs the wound with gauze impregnated with sulfanilamide. Mathesheimer[116] treated 7 cases by the open method but used a preparation composed of 25 per cent ethylaminobenzoate and 75 per cent phenmethylol.

Cutler and Zollinger[39] suggested the use of Carnoy's solution, which is composed of absolute alcohol, 6 cc., chloroform, 3 cc., glacial acetic acid, 1 cc., and ferric chloride, 1 Gm. They reported 23 cases with good results.[38]

Method. Primarily, the sinus is freely incised and drained. A few days later the edges of the wound are protected with zinc oxide ointment and the cavity is filled with as much as 10 cc. of the solution, which is allowed to remain for from five to fifteen minutes. Similar treatments are given daily or every two days or, in some cases, at weekly intervals. Each time, the tissue that has been destroyed is curetted away.

Smiley,[148] Ferguson[56] and Larkin[96] are all enthusiastic about the results achieved.

B. Marsupialization. Buie[29, 30] applied the technic of marsupialization to pilonidal disease, which consists of incising the sac, emptying its contents and stitching its edges to the skin incision, thereby permitting the wound to heal by granulation. Four advantages are provided by this method, according to Buie: (1) extensive wounds are obviated; (2) the membrane formed by the anomalous development is utilized, which provides a satisfactory covering; (3) convalescence is reduced by suturing the edge of the cyst to the skin edge, and (4) by exteriorization, recurrence is less prone to occur.

Technic. A probe is introduced into the sinus and the tissues over it are split. Where multiple sinuses are present, each is treated in a similar fashion. The edges of the skin together with the external and lateral walls of the cyst and sinuses are excised, leaving intact the inner walls of the cyst and its branching tracts. The edges of the skin are then sutured to the margins of the remnant

cites the study by Rogers and Hall[112] leading to a conclusion with which he is in hearty accord. In a substantial series of cases the sinuses were injected with an aqueous suspension of India ink, 1:40. After this series into which injections of dye had been made suggests that the use of dye is dangerous if not definitely contraindicated."

Additional references may be found both for and against the use of dyes.[43, 60, 83, 104, 130]

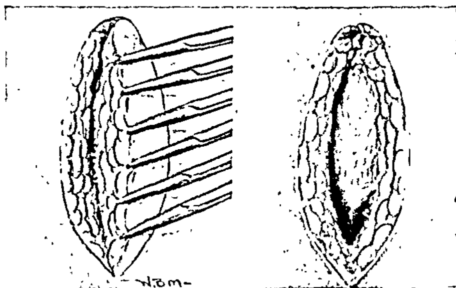


Fig. 669. (*Left*) Illustration of the elliptical incision; the inner edges being drawn medially. The opposite side is treated in a similar manner.

Fig. 670. (*Right*) Appearance following excision of the inflammatory process.

fixation in a dilute solution of paraldehyde, *1:10, for 24 hours, parallel longitudinal* slices were taken at intervals of from 2 to 3 mm. and numerous paraffin sections made. They thought that the ink-filled tracts could be visualized if the surrounding tissue were made transparent by means of a fat-clearing technic. After the process of clearing was completed, which consumed several weeks, it was found that the blood vessels filled with changed blood could not be distinguished from tracts containing ink. In three cases the coccyx had been removed because it was stained by the ink. Section, however, *failed to show* evidence of pathologic changes in the fascia of the bone. In other specimens, normal tissue outside the sinus tracts had been penetrated by the ink, while in some the ink only partially filled the tracts themselves. These investigators concluded, "The study of the specimens of

Operative Treatment. All will agree that *wide excision of the diseased* tissue should be performed in each case, but the best method of treating the resulting wound arouses much difference of opinion. *For the* purpose of clarity, these methods will be described under the following headings:

A. Excision—wound left open
B. Marsupialization
C. Excision—open wound with secondary closure
D. *Excision—with partial* closure
E. Excision—with primary closure
F. Excision—flap method with primary closure

A. Excision en Bloc — Wound Left Open. This is a very simple *procedure* and consists of removing all the diseased tissue in one piece, the resulting wound being allowed to granulate and fill in with scar *tis-*

pletely healed in from 21 to 26 days. R. Terrel[153] reports a similar experience. Bunch[31] utilized this method in 37 patients and believes that it offers the greatest hope of cure. In 17 patients, Todaro[157] and Prag observed complete healing in 16 and recurrence in 1. Van Dyke[162] and Coffey[33] are both enthusiastic because of the short period of hospitalization, minimal discomfort and low rate of recurrence. Granet and Palmer[68] are of the opinion that exposure, saucerization and curettage is the safest procedure. For recalcitrant cases, they recommend excision with plastic repair, utilizing split or sliding grafts.

A slight modification of this technic is cited by Block,[19] who, following incision of the tracts, destroys the membrane with Carnoy's solution (see p. 935). Marks[112] quite recently reported his experience in a series of 618 cases in which the original technic is further modified, which he terms "eventration." Here the center cavity and radiating branches are widely incised and the necrotic contents wiped away. Without excision of any tissue, the cut margins of the living epithelium and inflammatory base are sutured to the skin with cotton. Finally, Carnoy's solution is applied to the cavity. Of the cases followed (number not stated), 5 broke down, and 3 required extended incision. In a group of 153 cases, Zimmermann[172] simply unroofed the infected cavity and permitted the membrane to remain intact except for wiping away the debris. The average for complete epithelialization was 23 days.

C. Excision—Open Wound with Secondary Closure. In principle, this procedure seems rational because, following excision, the wound is packed or treated with wet dressings until quiescent. Then the wound is closed by suture. It offers the disadvantage, however, of necessitating two stages. In addition, the convalescent period is more often protracted than in the method of primary closure, with little or no gain in the percentage of permanent cures.[15, 35]

Comment. Burns[32] reports 240 cases, of which 106 were done by excision and secondary closure. Of these, 65 were followed, of which 54, or 86 per cent, were cured. Kennard[98] treated 50 cases by this method using alloy steel wire and penicillin (30,000 units every 3 hours postoperatively); 88 per cent were discharged as cured.

D. Excision with Partial Closure. Various technics of partial closure have been suggested,[32, 97, 122, 167] but suffice it to state that it is not particularly popular. In our experience, however, it has proved most satisfactory, and although we have employed other methods for trial, we invariably return to this technic, which has been used during the past ten years without change.

Technic. Under low spinal analgesia, the extent of the process is determined, and then the customary "excision en bloc" is performed. No dyes are employed. The dissection is carefully carried out on each side and below the cyst base down to the underlying fascia. Bleeding points are ligated. A single row of interrupted sutures are placed approximately one-half inch apart through the subcutaneous tissue and fat on one side, including the fascia in the midline, and through the fat and subcutaneous tissue on the other side. No. 32 alloy steel wire is used. All sutures are introduced before tying. This offers partial closure with the skin itself gaping about three eighths of an inch. These wire sutures are not removed at any time. The ends are cut immediately above the square knot. A tincture of benzoin dressing is applied and removed in 24 hours. Sterile gauze is used thereafter. Patients are discharged between the third and fifth postoperative day.

Comment. From 1938 to 1947, there have been 304 private patients with pilonidal disease subjected to some type of operation. In the vast majority, this method was employed. Although an accurate record is not available of all patients in this group, there are 84 consecutive cases in which pertinent data may be cited. The average period of hospitalization was 3¼ days. The average

of membrane which originally enclosed the cyst and sinuses.

Comment. There are numerous published reports attesting to the value of this method. Brockbank and Floyd,[23] for example, employed marsupialization in 168 consecutive cases and mention that fully 90 per cent of their patients were com-

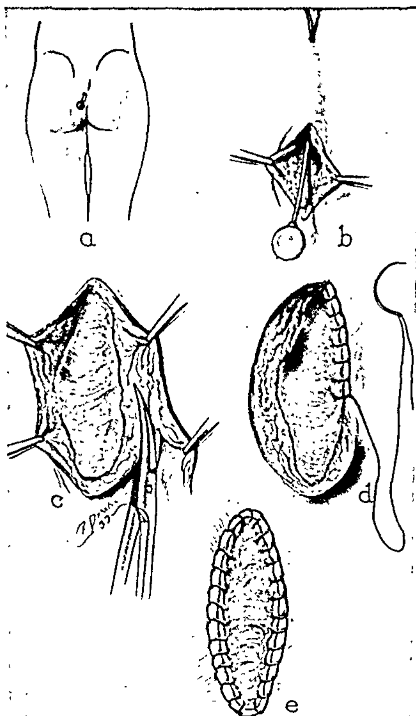


FIG. 671. Operation for pilonidal disease: (a) Probe inserted into sinus; (b) sinus and cyst partially slit open; (c) overhanging edges being cut away (external position of wall of cyst already excised); (d) cut margin of wall of cyst sutured to free edge of skin; (e) operation complete and pilonidal cyst exteriorized. (L. A. Buie: Practical Proctology, Philadelphia, Saunders, p. 481.)

F. Excision—Flap Method with Primary Closure. Over a period of years, numerous technics and modifications have been advocated employing various type of incisions.[21, 26, 79, 82, 91, 92, 120] Shute, Smith and Burch[147] describe a method in which a wide double elliptical incision is made perpendicular to the fascia of the gluteus maximus. The circumscribed block of tissue is removed and a lateral incision carried through the gluteal fascia on each side in the line of the original incision. It is deepened into the fibers of the muscle, and the fibromuscular flap thus created is turned medially and sutured to its fellow of the opposite side in the midline. In a series of 59 cases, 48 healed primarily in an average of eight days. Pope and Hudson[130] employ a sliding gluteus muscle graft technic in which a single side of the muscle is mobilized. Ninety-two patients were treated by this method with complications in 15 per cent; in 38 control cases of simple closure the incidence of complications was 21 per cent.

Martin[115] devised a technic using a plastic skin flap which has become increasingly popular. Following incision, the skin is retracted and mobilized by undercutting. When possible, all of the involved areas are excised down to the sacral fascia without exposing the infected cavity; if it is exposed, however, the operation is continued. Partial fat excision leaves a better buttock contour. The ligament joining the anus and coccyx is left intact or repaired, thus assisting in prevention of retraction-sulci at the posterior end of the wound. Skin flaps are tried for coverage and free mobility. Mattress sutures are used, the skin being sutured to the sacral fascia, using No. 0 catgut. If the flaps are properly mobilized, no tension is present. A gutter or tract is left in the base of the wound for drainage.

Postoperative Treatment. The aftercare of these patients is of utmost importance and will do much toward diminishing the period of convalescence and effecting a permanent cure.

Open Method. Ordinarily the packing is removed at the end of 24 hours, at which time the patient is permitted out of bed and sitz baths are prescribed thrice daily thereafter. The wound is simply dressed with plain gauze tucked lightly into the wound. Exuberant granulations and attempts at "bridging" are removed by curettage with gauze.

Closed Method. Dressings are changed at the expiration of 48 hours and the operative area cleansed. Since only alloy steel wire sutures are buried in the depth of the wound and not through the skin, they are not removed. The wound is inspected frequently, cleansed and sterile gauze applied, held in place by straps of adhesive or T-binder. More recently penicillin intramuscularly and with urethrane locally has been used during the 4-day period of hospitalization.

Recurrence Following Open and Closed Methods. Rogers and Hall[142] cite their results in a series of 141 cases:

	Number of Cases	Percentage of Recurrence
Primary closure	41	37
Partial closure	25	75
Open packing	75	21.5

After separation of the cases previously operated from those not operated upon, the comparative recurrence rates are as follows:

Cases having previous operation (Recurrent)	Percentage of Recurrence
Primary closure	100
Partial closure	88
Open packing	58

Cases not having previous operation (Original)	Percentage of Recurrence
Primary closure	31
Partial closure	31
Open packing	3

Another series is reported by Breidenbach and Wilson.[25]

	Total Number of Cases	Number Cases Followed	Number Cures	Percentage of Cures
Open packing	132	32	30	94
Suture and packing	79	24	15	63 } 62%
Suture alone	29	18	10	56 } 62%
Suture and drainage	27	9	6	66 } 62%

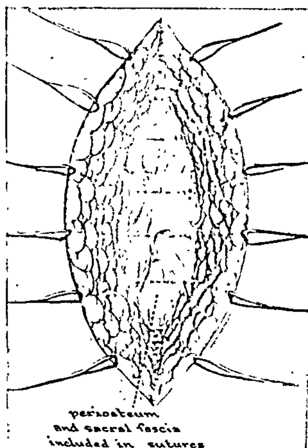


FIG. 672. Introduction of catgut or steel-alloy wire sutures.

period from date of operation until complete healing was noted was 39 days; 11 broke down on one occasion and required curettage; 5 broke down twice, and 2 on three occasions. No patient required a secondary period of hospitalization. All cases were followed in this group, but it is only fair to state that all were carefully selected (see Summary).

Alley[5] cites an average of 26.5 days for complete healing with excision and suture using figure-eight alloy steel wire.

A method of partial closure deserving mention is that outlined by De Prizio.[43] Here the excess fat is removed, which reduces the depth of the healing cavity, and the skin edges are undercut and sutured in the base of the wound. Fourteen patients were treated in this fashion using silk or linen for suture material. No recurrence was noted. In a group of 150 cases subjected to some type of excision, Theis *et al.*[153] found that the best results were obtained by a modified partial closure. Of 37 patients, infection was noted in 18.9 per cent, hematoma in 2.7 per cent and recurrence in 5.4 per cent. These authors also observed that sulfonamide therapy was of no value locally yet was helpful by oral administration.

E. EXCISION AND PRIMARY CLOSURE. Here the infected tissue is removed in its entirety in the manner previously described and the wound completely closed, provided, of course, the case conforms to the rules outlined for primary suture. Bleeding vessels having been grasped and tied securely, buried interrupted sutures of alloy steel wire are inserted through the entire depth of the fat and, after the periosteum is caught over the sacrum, are brought through on the opposite side. (Fig. 672.) All sutures are tied, after which the skin is closed with interrupted black silk, care being taken to avoid inversion of the skin edge. In this manner all dead spaces should be completely obliterated. A roll of gauze is placed over the suture line and supported by gauze pads over which a tight adhesive reinforcement is applied.

Results. It is generally recognized that while the immediate result is more desirable, the incidence of recurrence is extremely high. Such has been cited by Kleckner[116] in his survey. It may not be amiss, however, to review briefly a few recent reports. For example, Larsen,[93] in a series of 225 cases, using cotton for suture material, observed primary healing in 218, or 96.9 per cent, and secondary healing in 7, or 3.1 per cent. He found that sulfanilamide did not protect tissues from infection but made the wound wet and difficult to close. Larkin[96] employed primary closure and penicillin in 100 consecutive cases. Primary healing was obtained in 90.9 per cent. In another group of 100 cases, Woods *et al.*[170] observed healing per primum in 65 per cent. Additional reports are available on primary closure by MacFee,[105] Bunch,[31] Hamilton,[69] Bartlett[11] and Adcock.[2]

Ewell and Jackson[50] employ the classification of dermoids, teratoma, fibrosarcoma, chondromyxosarcoma, glioma and the "histologic potpourri" of Rindfleisch, the most common being the dermoid. According to Craig, inclusion cysts developing in relation to the spinal cord and its meninges are rare, but periodic literature records their presence. He classifies them as (1) epidermoids or cholesteatoma; (2) dermoids and (3) teratoma.

Incidence

Contrary to popular opinion, these tumors and cysts are not extremely rare. Records show that they are more common in females,[18, 33] which, according to one,[10] is supportive evidence that such have their original seat in the ovary. Both varieties of tumor are more frequent in the newborn, although a considerable number have been reported in adults, usually between the ages of 15 and 30.[94] Others have been cited as late as 84 years.[94]

According to Brandes[24] and Sutton, the coccygeal region is often the site of anomalous developments and tumors. They quote Calbet, who collected 203 ventrally located sacral tumors in 34,582 births. Whittaker and Pemberton[168] reported the incidence as being one in every 40,000 births; they cited 22 cases, 9 of them being dermoids. Brindley,[27] within 14 months, observed a chordoma, an ependymal cell glioma and a large dermoid cyst. Ericsson[48] reported a ventral meningocele in a secundipara and tabulated 26 cases, chiefly in women. Huene,[75] in his investigations on tumors, stated that this entity was composed of various tissues, organs or systems of organs not normally existing at the place of tumor location. He believed all to be congenital, either existing at birth or developing because the child was born possessing the essential tumor matrix. He described two types, external and internal. To the former belong the parasitic and suppressed fetus, the parasitic being the result of embryotic bifusion, one going into complete development and the other into partial development.

Etiologic Hypotheses

A discussion of these growths, which occur most frequently behind the rectum, would be incomplete without a brief reference to some of the more important theories concerning their origin. As has been previously mentioned, disturbances in the caudal region may bring about transplantation of the coccygeal vestiges and give rise to tumors in this site.[12] There are those who believe that these growths are derived from remnants of the postanal gut, neurenteric canal and medullary canal, together with ectodermal and mesodermal inclusions.[33, 87, 119] Middledorpf described tumors in this region, but Whittaker and Pemberton[168] gave their opinion that the term should have been limited to teratoid tumors arising in the postanal gut. Others[14, 61] found it difficult to explain the presence of the more complex teratomata by the monogerminal theory and suggested that these tumors represented an incomplete monstrosity or twin, a so-called suppressed fetus. Such was known as the bigerminal theory. According to one,[13] teratomata with their three embryonic layers are to be regarded as arising from a segregated blastomere or impregnated pole cell. That the cells have the peculiar property of reproducing three primary germinal layers following some exciting cause has been suggested in an effort to explain their presence.[1] One of the most lucid explanations of teratomata is that the mucosa is derived from the postanal gut, the bone and cartilage from the coccyx and the nerve tissue from the neural tube, together with various inclusions.[117]

Carney[33] is of the opinion that dermoids would seem to originate most probably from the vestigial neurenteric canal; it is generally agreed, however, that they arise from an ectodermal portion, separated during faulty coalescence or invagination of a portion failing to atrophy.

Granet,[67] in 317 consecutive admissions for inflammatory pilonidal disease, found that 25 per cent were admitted because of recurrence. It was further determined that 72 per cent of the recurrences had been operated upon by primary closure, whereas 28 per cent of the recurrences had been operated upon by some type of an open method.

A.	Number of cases of pilonidal sinus operated using "open method"	4,231
	Number of cases showing recurrence	48
	Percentage of recurrence in this series using "open method"	1.13
B.	Number of cases operated using "primary suture"	365
	Number of cases showing recurrence	85
	Percentage or recurrence in this series using "primary suture"	23.29
C.	Number of cases operated upon in which primary suture was used and stitches were removed because of infection, healing therefore by open granulation, or in which sutures and drainage were used with more or less infection present	103
	Number of cases showing recurrence	5
	Percentage of recurrence	4.86
D.	Members (American Proctologic Society) preferring open method	87 %
	Members preferring primary suture	7½%
	Members using both	5½%

The value of the open method is further substantiated by the excellent survey reported by Kleckner[69] from a questionnaire issued to members of the American Proctologic Society. (See above chart.)

Summary

Strangely enough, scanning the few hundred articles extant, which were based on a wealth of clinical material resulting from and written during World War II, little has been achieved in relation to the precise surgical management of pilonidal disease. It is, however, generally conceded that permanency of cure is best accomplished by complete excision of both cyst and all adjacent sinus tracts. Additionally, it must be realized that with the wound remaining open and permitted to granulate in from its base, the highest percentage of permanent cure and lowest incidence of recurrence is achieved, although the period of convalescence is prolonged. Conversely, with the closed method as an inclusive group, lower percentages of permanent cure and higher incidences of recurrence can be expected but periods of convalescence are correspondingly shorter. Thus, the rationale of the open, compared to the closed, method is and probably always will be a controversial point.

Our approach to the problem has remained practically static during the past decade, and while the results attained, both immediate and final, are by no means definite and conclusive, the over-all summation has appeared more than satisfactory.

A. Pilonidal cysts and sinuses presenting acute abscess formation are simply incised and drained. Following a period of approximately four days, marsupialization is instituted.

B. Recurrent cases and those presenting extensive and/or multiple tracts, and those disclosing definite involvement of the coccyx or sacrum, are excised in their entirety and left open to granulate in from the base.

C. Those devoid of an acute inflammatory process are partially closed, providing (1) all existing pathology is removed, (2) hemostasis is complete, (3) all dead spaces are obliterated and (4) alloy steel wire (32 gauge) sutures are interruptedly placed.

DERMOIDS AND TERATOMAS

The study of these tumors is very interesting, and for the student, especially, it would be most helpful to separate them sharply so far as their origin and histologic characteristics are concerned; however, when the embryologist and pathologist fail to arrive at an accepted classification, it is quite impossible for the clinician to do so.

McLanahan and Stone, who reported two cases, one in an infant, the other in a man 68 years old. Hullsick gave his opinion that a factor entering into anorectal cyst formation is the presence of the deep, epithelial-lined tracts beginning in the columns of Morgagni; recent investigations make it evident that these ducts are the etiologic factor in many perianal abscesses, fistulae and blind internal sinuses, and there seems to be no valid reason otherwise apparent, in the absence of inflammation, why they might not produce such cysts.

Dermoids and teratomas may have their origin behind the rectum, in the wall of the rectum or in the rectovaginal septum. When they are located outside the rectum, spontaneous rupture with discharge of its contents into the rectum may occur. As is more usual, rupture through the perineum is apt to take place, in which case one and sometimes two openings are to be found in the midline between the tip of the coccyx and the anus. (Fig. 673.) The size, shape and consistency of dermoids and teratomata are extremely variable. Those situated anterior to the sacrum and between it and the rectum are of larger size than those found posterior to the bone.[77] They vary from the size of an apple to that of a fetal head. Usually the shape is ovoid and the consistency firm, if solid, and boggy if cystic. Growths behind the rectum seem fairly well fixed to the surrounding structures, but those in the rectal wall are freely movable because they usually possess a pedicle. As previously mentioned, dermoids and teratomas may arise in the rectal wall. A perusal of the recorded cases shows that these growths are usually pedunculated, the base of the pedicle being located approximately two and one-half inches above the anus and more frequently posterior than anterior. A rather unusual case of teratoma having its origin in the sigmoid flexure has been reported.[34] A most characteristic picture of a solid rectal teratoma (case of Fried and Stone)[62] is shown in the accompanying illustration. (Figs. 674, 678.)

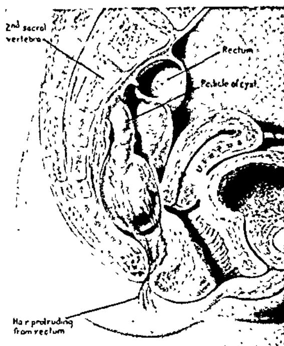


Fig. 674. Teratoma of rectum. (H. Fried and H. B. Stone: Surg., Gynec. & Obst. 50:762.)

Several instances have been reported where the growth itself or its contents have been expelled through the rectum during labor[145, 161] or defecation.[7, 41, 81] Ordinarily the hair is of different texture and color than that present elsewhere on the individual.

Lash[99] reported a case of teratoma of the perineum in a newborn infant delivered by prophylactic outlet forceps and episiotomy. The mass was 2.5 cm. long and approximately 1 cm. in diameter, extending from the perineum just below the fourchette. Neal and Carlisle[128] report a case of perineal teratoma. The mass was located in the perineogluteal region, much larger than the fetal head, and was the causative factor obstructing delivery. Histologically, the tumor was composed of adipose tissue, skeletal muscles, nerve bundles, fibrous and myxomatous tissue and multispaced tissue or, in reality, alveoli. It was lined with mucous-forming columnar epithelium, varying from a low to tall type and identified as of intestinal tract origin; some areas had

Pathology

Dermoids are usually cystic tumors abnormally situated. They present cavities lined with squamous epithelium from which livered manually. On removal from the fetus, it proved to contain multicystic spaces lined with columnar epithelium, glial tissue and esophageal epithelium; it was a trigerminal type of tumor.

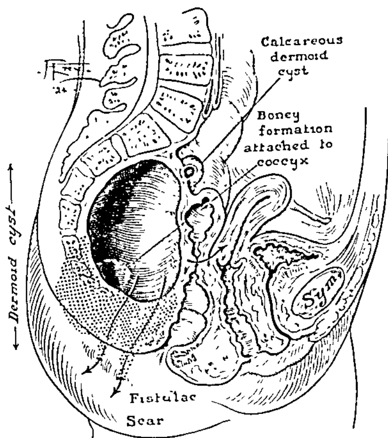


Fig. 673. Sagittal section through the pelvis showing the location of a dermoid and sinus in the left buttock. (Masson: Surg. Clin. North America 5:740.)

certain cutaneous appendages, such as hair and sebaceous glands, have developed. On section the wall is tough and the cavities are filled with greasy material of buttery consistency. When more complex tissues are represented, such as teeth, bone, fat, cartilage, muscle, segments of intestinal mucosa and nerve structures, it is designated teratoma or teratomatous (teratoid) tumor. (Fig. 676.) A teratoma, therefore, may be defined as a tumor consisting of different tissues or organs derived from more than one germ layer.

Huene[75] reported a case of a fetal sacral teratoma which blocked the mother's birth canal; both fetus and attached teratoma de-

This type of tumor may be cystic or solid. The lining of the cystic portions may be cylindric, cuboid, ciliated or pavement epithelium. (Fig. 677.)

Dermoids and teratoid tumors are encapsulated and usually attached to the periosteum of the sacrum but have no actual connection with it. Most frequently they are found between the rectum and the sacrum, although they may extend over the dorsal surface of the latter.[51, 87]

Hullsiek[76] remarked that enterogenous or enteric cysts occur not infrequently at many points along the intestinal tract; but a research of the literature for 10 years revealed few with rectal locations. He quoted

a mass may be visible. (Fig. 675.) In the vast majority of cases one or even two draining sinuses may be noted in the midline between the tip of the coccyx and the anus in suppurating postanal tumors. On rectal palpation an indefinite mass is usually felt in the hollow of the sacrum. A bimanual examination should always be resorted to, with one finger in the rectum and the other hand over the coccyx. In this way, much information may be obtained as to the size and consistency. Rectal growths are pedunculated, smooth and covered with skin and hair.



Fig. 675. Sacrococcygeal teratoma. (W. E. Burnett.)

Differential Diagnosis

In differentiating teratomata from other pathologic entities found in this region, it is to be remembered that a teratoma resulting from parthenogenetic development of a sex cell would be of the nature of an offspring, while one derived from an isolated blastomere would be of the same generation as the host, i.e., a twin.

In differentiating them from meningomyeloceles, the skin covering of the teratoma is the true variety; that of the meningomyelocele is usually a thin, embryonal type of skin, easily eroded and ulcerated.

Size variance is encountered in teratomata, especially in early life. At this time rapid increase in size is apparent, paralleling growth of the host. Meningomyeloceles do not possess this phase of growth.

Teratomata contain both solid and cystic portions,[75] are irreducible and show no enlargement or increased tension when the child cries or when the jugular veins are compressed.[164] The meningomyeloceles are distinctly cystic, showing various evidences of communication with the spinal subarachnoid space, and neither motor nor sensory disturbances, except in rare instances, are noted in teratoma unless the tumor presses on the lumbosacral plexuses. Loss of sphincteric control with sensory and motor disturbances in the buttocks and lower extremities are phases seen in the meningomyelocele group; hydrocephalus is often present.

In differential diagnosis of urinary retention from other extraneous factors, this condition is always to be considered when dealing with young infants presenting acute urinary retention, as the coccyx is fre-

epithelium suggestive of that normally lining pulmonary alveoli and bronchioles. It had been necessary to partially dismember the body to effect delivery. The child was a full-term female infant. Brandes[24] and Sutton described a case of presacral cyst apparently arising from the neurenteric canal in a newborn infant; x-rays showed the mass in the perineogluteal region. The sacrum and the coccyx were underdeveloped with displacement of the last two segments. The mass measured 10 x 12 cm., weighing 340 Gm. On microscopic examination: thin covering of skin with short rete pegs and slight keratinization of the epidermal surface layers; corium structure normal. Sections cut from multiple areas showed thin, glial tissue lining with short extensions into the surrounding fibrous stroma; many cell areas with perpendicular arrangement were found, resting on the underlying glial tissue. Clinically, there was no evidence of central nervous system connection, and, postoperatively, no spinal fluid leakage occurred. Pack and Braund[133] cited a sacrococcygeal teratoid tumor in a male infant four weeks old, spontaneously delivered at term. The tumor was extirpated one year following birth; it was composed of fat, connective tissue, bone, hair fragments and a large length of intestine which, when uncoiled, measured 78 cm. in length. Along the course of this intestinal loop, three small outpocketings were present, containing clear, watery fluid. Microscopically, this cloacal sac, or diverticulum, was identified as the urinary bladder. Study of various portions disclosed structures such as a well formed adrenal lacking medulla, a poorly formed brain, fetal fat, epidermis, a well formed urinary bladder, large intestine, bone, cartilage and a questionable bronchus. The child was discharged from the hospital 17 days postoperatively. De Veer and Browder[164] reported four cases of sacrococcygeal teratoma and, for comparison, one example of a sacral meningomyelocele to illustrate the respective diagnostic features. In one, a two-months-old male, the mass measured 12 x 10 x 6 cm. and contained several irregular-shaped cavities. Microscopically, the solid portions consisted mainly of lobulated masses of brain tissue with varying degrees of gliosis; an occasional island of bone was noted. Cystic spaces were lined with epithelium resembling bronchial and gastro-intestinal mucosa; the child lived. Woodruff and Bergner[192] described a case of a sacrococcygeal teratoma in an infant five months old causing acute urinary retention and obstruction. The child was hospitalized owing to his inability to void for three weeks; no other pathology had been present since birth. The urinary bladder was palpable on examination just caudad to the umbilicus. Intravenous urogram disclosed normal left ureter but the right (lower half), was displaced dextrally, due to possible extrinsic pressure. The child died 21 hours postoperatively. Had it not been for a digital rectal examination, which gave the first inkling as to the proper diagnosis, the procedures which followed might not have been effected.

Symptoms

In the adult the tumors are seldom recognized until they give rise to symptoms of pressure or infection. Of course, a history of expelling a mass or mat of hair during labor or at the time of defecation may be cited. The protrusion of hair from the anus may be mentioned also. Constipation, difficult defecation at times bordering on tenesmus, heaviness in the pelvis and constant dull ache over the sacrum are usually complained of by the patient. Bleeding is uncommon. Pressure symptoms with accentuation of the above, and a draining sinus in the perineum behind the anus from which purulent material may discharge and hair may protrude, are more characteristic where the growth is located behind the rectum. (Figs. 675, 676, 677, 678.)

Diagnosis

Discoloration of the skin over the sacrum and behind the anus, and the presence of

ency of the growths to infiltrate. Although it seldom gives rise to metastasis, malignant degeneration may supervene, as has been reported in a few instances.[11, 23, 27, 77, 101, 125, 128, 131, 104] For example, De Veer and Browder quoted Penner and Goodsit as reporting the case of an infant from whom a "tail-like mass," a teratoma, was removed shortly after birth. Ten months later the child was found to have a malignant teratoma located between the rectum and sacrum, infiltrating the rectal wall. Lisco[104] reported ten cases from the Department of Pathology at Johns Hopkins Hospital occurring during the period from 1897 to 1937. There were six males and four females. The earliest age at the time of death was 11 months; the latest age, 3 years 3 months. Nine were autopsied. The types of lesion present included papillary adenocarcinoma (4), adenocarcinoma (2), "alveolar sarcoma" (1), embryonal carcinoma (1) and chondrosarcoma (1). Metastases to the lungs alone occurred in two cases; to the lymph nodes alone, two cases; rectal invasion, one; lungs, liver and lymph nodes in two. In two cases, malignancy developed in the teratoma and had infiltrated adjacent tissues, metastasizing to various organs. Both were congenital sacrococcygeal teratomas found at, or soon following, birth, and derivatives of all three germinal layers were found in both tumors. From the cases reported, it is of interest to note the frequency of papillomatous adenocarcinomata. Moreover, all but two were malignant tumors of epithelial origin.

Treatment

The most satisfactory treatment that can be offered is surgical extirpation followed by radiotherapy. For low-lying, pedunculated rectal growths this should not be difficult. Those situated between the sacrum and rectum are best approached through a midline incision extending from the sacrum almost to the anus. In some cases it may be necessary to sacrifice the coccyx and a small portion of one side of the lowermost segment of the sacrum to obtain exposure.[133] The use of radium following removal of the growth has been attended by good results.[77, 101, 150]

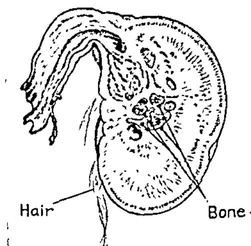


Fig. 678. Teratoma of rectum, cut surface. (H. Fried and H. B. Stone: Surg., Gynec. & Obst. 50:762.)

CHORDOMA

Sacrococcygeal chordoma or chordoblastoma is extremely rare. Because it usually presents an anorectal syndrome and because of the fact that it is almost always palpated through the rectum, this variety of tumor is deserving of consideration. Brindley[27] stated that individual experience is naturally limited in connection with these tumors due to their being rarely seen. He reported a case in 1942 in which complete removal had been possible due to its small size. Harvey[70] and Dawson found the tumor more frequent than fully recognized, but it still remains a rarity. In a survey of their tumor slides and material which, in 1941, amounted to nearly 16,000 items, specimens from all body regions, they were enabled to separate only 14 definite and 5 doubtful chordomas.

So far as age and sex are concerned, the condition is found most frequently between 25 and 55; males being affected more than females in the proportion of 3 to 1.[107]

quently the starting point for teratoma.[169]

It should be remembered that perianal abscesses, fistulae and blind, internal sinuses occur in this region and also cystic formations. Enterogenous cysts reported by Hullsiek in two cases occurred as extrarectal masses.[70] Absence of severe pain together with a relatively low leukocyte count make the differentiation easy.



Fig. 676. (*Left*) Photomicrograph of sacrococcygeal tumor (Fig. 675), low-power magnification through tumor, showing area of cartilage in left lower portion of the picture and two cystic acini lined with tall columnar ciliated epithelium; in the same section a hair follicle and stratified squamous epithelium. The remainder of the tissue consists of undifferentiated tumor cells.

Fig. 677. (*Right*) Photomicrograph of same tumor. Low-power section, showing many cystic cavities lined with columnar and stratified squamous epithelium and hair follicles.

Teratomas are to be distinguished from dermoids in that all three germ layers are invariably present in the former while the latter are of ectodermal origin exclusively. The teratoid, with its great degree of differentiation, rarely undergoes malignant transformation, although there have been examples of this development with local recurrences following removal and distant metastases resulting in death.[133]

Ventral sacral meningoceles are to be differentiated from teratoma[48] in that failure of the vertebrae to consolidate is a primary cause and protrusion of a meningeal hernia through the defect a secondary contributing factor. Ericsson[49] reported a case in a secundipara, age 33.

In differentiating teratoma from chordoma, one should be mindful that the latter entity is extremely rare, presents anorectal syndromes and is almost always palpable intrarectally. It is found most frequently between 25 and 55, affecting males in the proportion of three to one, whereas teratomata invariably occur in early life.

Prognosis

So far as the teratomata are concerned, it has been stated that one third of the subjects are born dead and 90 per cent die within a few days.[169] For those who survive and present symptoms in later life, the prognosis is guarded because of the tend-

ency of the growths to infiltrate. Although it seldom gives rise to metastasis, malignant degeneration may supervene, as has been reported in a few instances.[14, 23, 27, 77, 101, 125, 129, 135, 164] For example, De Veer and Browder quoted Penner and Goodsit as reporting the case of an infant from whom a "tail-like mass," a teratoma, was removed shortly after birth. Ten months later the child was found to have a malignant teratoma located between the rectum and sacrum, infiltrating the rectal wall. Lisco[101] reported ten cases from the Department of Pathology at Johns Hopkins Hospital occurring during the period from 1897 to 1937. There were six males and four females. The earliest age at the time of death was 11 months; the latest age, 3 years 3 months. Nine were autopsied. The types of lesion present included papillary adenocarcinoma (4), adenocarcinoma (2), "alveolar sarcoma" (1), embryonal carcinoma (1) and chondrosarcoma (1). Metastases to the lungs alone occurred in two cases; to the lymph nodes alone, two cases; rectal invasion, one; lungs, liver and lymph nodes in two. In two cases, malignancy developed in the teratoma and had infiltrated adjacent tissues, metastasizing to various organs. Both were congenital sacrococcygeal teratomas found at, or soon following, birth, and derivatives of all three germinal layers were found in both tumors. From the cases reported, it is of interest to note the frequency of papillomatous adenocarcinomata. Moreover, all but two were malignant tumors of epithelial origin.

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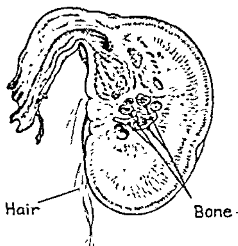


Fig. 678. Teratoma of rectum, cut surface. (H. Fried and H. B. Stone: Surg., Gynec. & Obst. 50:762.)

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Pathology

Chordoma,[139] first described by Luschka,[103] develops from the anlage of the notochord,[121] which is found in the centers of the intervertebral disks.[20] This tumor is usually lobulated, encapsulated, somewhat elastic, translucent and variable in size. Pototschnig[137] reported a case weighing 13 pounds. Keane,[84] discussing trauma as an etiologic factor, stated that differences of opinion are extant, these contentions being supported by the fact that the tumor occurs more commonly in males. Furthermore, investigators have shown that traumatism of the intervertebral disks in rabbits produced nucleus pulposus herniation resulting in proliferative change in the chordal rests and having the appearance histologically of chordoma. Additionally, the history of injury is usually elicited. Although it grows slowly, this variety of tumor infiltrates the bone, thereby causing its destruction by invasion and pressure. It may extend anteriorly into the pelvis and invade the rectum,[2, 40] passing upward into the lumbar canal or laterally to the ischia. Rarely does it metastasize, although approximately 80 per cent become malignant.[79, 109, 138] Faust, Gilmore and Mudgett[53] stated that the benign and malignant chordomata are both notably rather slow-growing. In the former, the process may cover many months or several years before the presenting symptoms have attained sufficient severity to induce consultation for relief. In the latter, growth progress is likewise variable but usually much more rapid than the benign type, showing definite metastasis at the initial examination. Fortunately these metastases in the malignant type are in the minority, being found in adjacent lymph nodes and various organs. He reported a case of a colored male, age 23.

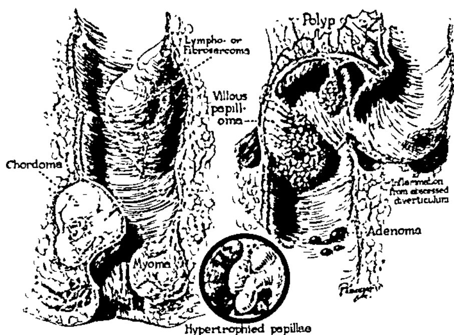


Fig. 679. Composite of various tumors (W. H. Daniel).

The nonmalignant form is usually situated at the clivus blumenbachii, the site of predilection also for the malignant form, now being more extensively reported. While a rarity in other sites, the sacrococcygeal region is the next most frequent site. From 1910 to *circa* 1944, 82 cases have been reported. Graf[66] personally reported 38 cases he found in the literature. The tumors were all locally invasive, almost invariably recurred following surgical removal and reacted poorly to roentgen treatment; some

grew to the size of a man's head. Metastases to distant organs were found in 10 cases.

He reported the case of a 58-year-old male physician, who had a sacrococcygeal chordoma which had spread over the entire lower dorsum, encircling the loins and hips up to the anterior surface of the abdomen, appearing as a huge, cauliflower-like mass of nodulations, forming a broad band 30 cm. in width and terminating anteriorly approximately 3 cm. from the midline. It had metastasized to regional and inguinal lymph nodes, the liver, lungs, pleura and skin of the right leg and thigh.

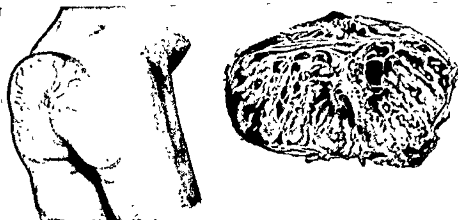


Fig. 680. Chordoma. (*Left*) Sacrococcygeal chordoma. The original tumor showing the dimple at the site of puncture 6 months before. (*Right*) Drawing of a section of the primary tumor showing the skin surface above, the extensive hyaline degeneration of the stroma and many areas of hemorrhage. (A. J. Hutton and A. Young: Surg., Gynec. & Obst. 48:333.)

Histopathology

The characteristics as tabulated by Fletcher[58] are (1) the formation of intracellular mucus, (2) the presence of physaliphorous[132] or huge, vacuolated, mucus-containing cells,[66] (3) the lobular arrangement of the tumor cells, which usually grow in cords, (4) the occasional occurrence of vacuolation of the nuclei, and (5) the close resemblance to notochordal tissue as seen in the nuclei pulposi[138] of the intervertebral disks.

Harvey and Dawson (*vide supra*) stated that there is a group of retroperitoneal or sacrococcygeal tumors, clinically and macroscopically resembling chordomata, which microscopically show fields of morphologic identity with chordoma but, at the same time, show puzzling fields of apparent glandular formations or organoid epithelial structure. On close examination, most of them have appeared not so glandular as at first, nor did the appearance suggest neuro-epithelial tubes, bidermal or tridermal teratoma. In none of these have any cartilaginous islands been found. They were loath to fall back on a glandular precursor stage of the chorda dorsalis and a presumptive reversion to this stage as a really final explanation of these tissues. It must always be remembered that the chorda dorsalis in the human embryo and adult is in itself a vestigial structure.

Symptoms

In the vast majority of cases, a history of some antecedent injury to the sacrococcygeal region is cited by the patient.[84, 86, 132] Pain is an early and constant symptom and may be confined to the sacrococcygeal, anorectal, gluteal or perineal regions with sciatic radiation. Loss of sphincteric control paralysis and various paraesthesias of the lower extremities have been recorded.[173]

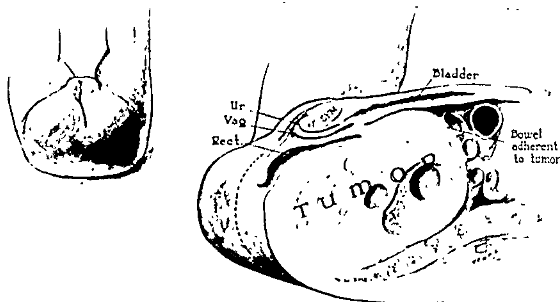


Fig. 681. Presacral adult type teratoma extending upward into the abdomen and downward between the coccyx and the anus, successfully removed by abdominosacral operation at the age of 9 months. (R. K. Brown and E. C. Brown.)

Vesical dysfunction is not uncommon. Olsman and Lev[172] report a case which perforated into the peritoneal cavity; the patient was a male, age 75, admitted as a psychotic with attendant cerebral arteriosclerosis; basal spinal injury 11 years prior to admission. Clinically the case proved unusual due to the peritoneal involvement and attendant production of an acute peritonitis. Otherwise, symptomatology of progressing sacrococcygeal chordoma was present. The reported spinal injury was of interest, as Babrey found trauma a causative factor in 26 per cent of all sacrococcygeal involvements, and Fletcher, Woltman and Adson found it to be present in 2 of their cases. Pathologically, the growth was relatively benign; a great deal of mucinous material and physalipherous cellular elements and a few compact, small, epithelial-like cells without mitosis were part of the picture.

Diagnosis

A chordoma can be palpated usually through the rectum but because it varies in size and consistency the diagnosis is difficult, except by macroscopic and microscopic examination. Studies with iodized poppyseed oil, 40 per cent, may prove helpful in the early stages of this disease. Roentgenographic diagnosis is fairly easily made. Urologists should have reported the entity more often, since urinary symptoms are the first, most important and most pronounced of the disease. By roentgenographic studies, vacuolation and thickening of the bony trabeculae with pelvic inlet flattening are to be demonstrated. The entity should be differentiated from Paget's disease and osteitis fibrosis septica. The entities to be excluded are tuberculosis, chondroma, chondrosarcoma, benign giant-cell tumors and colloid carcinoma.

Treatment

While complete eradication of the growth is practically impossible because such would necessitate total excision of the sacrum, partial removal, or as much as is deemed advisable, is recommended for the purpose of alleviating pain and preventing spread of the process. Good results have been recorded.[173] Excision of the growth through a posterior approach is preferable. Following operation, deep x-ray therapy and barrage with radium is advocated.[78, 175]



FIG. 682. (A, *Left*) Sebaceous cyst of the perianal region. (B, *Right*) Pilonidal cyst with epitheloid degeneration (Dr. H. C. Schneider).

CYSTOMATA

Cysts may be congenital or acquired. They are uncommon about the anus and are extremely unusual within the rectum. They are present as globular swellings of variable size and may be single or multiple. (Fig. 682.) They may be attached by a broad base or by a pedicle, are movable, moderately soft and cause no pain unless complicated by inflammatory change. These cysts contain semisolid cheesy material.

TREATMENT

The treatment is excision. Following infiltration of the base with novocaine, the cyst can usually be removed in its entirety through an elliptical incision. Bleeding is controlled and the wound closed with sutures.

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CHAPTER 26

Anesthesia and Analgesia

GENERAL CONSIDERATIONS OF ANESTHESIA

Anesthesia is the abolition or loss of sensation. Surgical anesthesia is a condition of insensibility, artificially produced, without interference with vital function. Analgesia is the loss of pain sensation. Surgical analgesia is a condition in which the sensation of pain is inhibited. Any drug sufficiently powerful to produce unconsciousness is potentially dangerous. The same is true when it is injected intradurally or around the sympathetic nerve ganglia. Therefore the choice of an anesthetic or analgesic and its method of administration are important factors in operations on the anus, rectum and colon and as such should receive the most careful consideration.

With general anesthesia, a state of unconsciousness and insensibility is induced, while in regional analgesia the sensation of pain is inhibited in a part of the body by obtunding the peripheral nerve endings, the conducting nerve pathways, or the receiving neurons of pain perception. For operative purposes, one must be mindful that analgesia, per se, is not real anesthesia, but rather an inhibition or paralysis of the pain-conducting fibers to a particular area; therefore, tactile sense is not usually impaired, as evidenced by the patient's interpretation of touch or temperature as such, although at the same time there is total absence of pain.

PREOPERATIVE EXAMINATION AND MEDICATION

The anesthesiologist determines the patient's anesthetic and surgical risk by personal interview. The history, physical examination and laboratory studies are reviewed. In selecting the preoperative medications, anesthetic agent and technic, he considers the age, sex, state of health, severity of the present illness, disturbances of the ductless glands and diseases of the gastro-intestinal, circulatory, respiratory, genito-urinary and nervous systems. The presence of cardiac decompensation, convulsions, alcoholism, liver diseases, diabetes and anemia, requires particular attention. Finally, by sympathetic discussion, the patient's nervous apprehension is allayed and his confidence and co-operation are gained.

Preoperative medication is purposed to (1) induce a state of narcosis in which the patient is calm and drowsy but not stuporous, co-operative but amnesic; (2) diminish secretions from the salivary glands, gastro-intestinal tract and tracheobronchial epithelium; (3) repress undesirable actions of the anesthetic agent; (4) raise the threshold against reflex sensory stimuli from the operative area; (5) depress the metabolism and hence the amount of oxygen required.

Generally, a larger dose of the preoperative medicaments is required for nervous

patients, children and those with a rapid metabolic rate, fever, pain or alcoholism. The dosage is reduced for elderly patients, for those who present an increased risk, and for patients who have jaundice, liver damage or hypothyroidism.

The three general classes of preoperative medications are opium, barbituric acid and belladonna derivatives. In general, the opium and barbituric acid groups are sedatives. These afford protection against the toxic effects of cocaine substitutes, while the belladonna derivatives are metabolic stimulants. They also diminish mucous secretions and lessen reflex response to cardiac vagal activity.

Barbiturates are not commonly administered to elderly persons, children or asthmatics; they are also interdicted in patients with debility, a sensitivity to this

SUGGESTED ORDERS. For good risk, vigorous adults (F. Audin)

Inhalation Anesthesia

Nembutal	gr. 1½	1½ hours preoperatively by mouth
Morphine sulfate	gr. 1/6	One hour preoperatively by subcutaneous route
Scopolamine hydrobromide	gr. 1/150	

Spinal Analgesia

Pantopon hydrochloride	gr. 1/3	Two hours preoperatively by subcutaneous route
Scopolamine hydrobromide	gr. 1/150	
Nembutal	gr. 1½	1½ hours preoperatively by mouth

Intravenous Anesthesia (Pentothal sodium)

Morphine sulfate	gr. 1/8-1/6	One hour preoperatively
Atropine sulfate	gr. 1/150	

Nembutal—omitted, due to fear of cumulative action of the barbituric acid derivatives

Regional or Local Analgesia

Morphine sulfate	gr. 1/6	One hour preoperatively
Scopolamine hydrobromide	gr. 1/300	
Nembutal	gr. 1½-3	Given 1½ hours preoperatively

PREOPERATIVE MEDICATION FOR PATIENTS WITH ASTHMA

Aminophyllin	gr. 3	H. S. and one hour preoperatively
Morphine sulfate	gr. 1/6	One hour preoperatively
Scopolamine hydrobromide	gr. 1/150	

MORPHINE SENSITIVITY—Use:

(1) Pantopon, or
(2) Dilaudid, or
(3) Demerol

PREOPERATIVE MEDICATION FOR CHILDREN

Morphine: give 1 mg. of morphine sulfate per year of age.
Do *not* give morphine sulfate to very young children, i e, under four years of age.

Years	Grams	Grains
4	0 004	1/16
8	0.008	1/8
16 and up	0 01	1/6

Nembutal· none to be used until sixteen years of age
Scopolamine or Atropine:

Years	Grams	Grains
0 - ½	0.000065	1/1000
½-1	0 00008	1/800
1	0 00011	1/600
5	0 00013	1/500
8	0 00016	1/400
12	0 00022	1/300
15	0.00032	1/200
16 and up	0.00043	1/150

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patients, children and those with a rapid metabolic rate, fever, pain or alcoholism. The dosage is reduced for elderly patients, for those who present an increased risk, and for patients who have jaundice, liver damage or hypothyroidism.

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5	0 00013	1/500
8	0 00016	1/400
12	0.00022	1/300
15	0 00032	1/200
16 and up	0 00043	1/150

group of drugs or a history of jaundice or liver damage. When sodium pentothal is to be used, the barbiturates are not administered preoperatively.

Pantopon is preferred to morphine since clinical impressions[39] suggest less incidence of nausea and emesis during the operative procedure.

Occasionally, little or no effect is obtained from the preoperative medication. In such cases, when spinal analgesia is employed, supplementary intravenous doses of morphine sulfate, from 1/12 to 1/16 grains, and scopolamine hydrobromide, from 1/200 to 1/300 grains, are administered following the intrathecal injection.

GENERAL ANESTHESIA

General anesthesia signifies loss of sensation and consciousness. It may be induced by a variety of agents which can be administered by (a) inhalation, (b) intravenous injection and (c) rectal instillation.

Ethyl-Ether. This produces excellent relaxation. Due to its wide margin of safety, it is the least dangerous drug for use by an inexperienced anesthetist. Ether is indicated when the insufflation or open-drop method is desired; it is particularly valuable when so administered to children, since the usual gas machine produces considerable resistance to their respiratory efforts.

Ether is contraindicated in the presence of acute respiratory infections, pulmonary tuberculosis, diseases of the liver and kidneys, acidosis, diabetes and increased intracranial pressure. It commonly produces postoperative nausea and vomiting. The author generally prefers other anesthetic agents to ether.

Chloroform is proscribed due to toxicity.

Divinyl-Ether. This is valuable for simple procedures, such as the incision and drainage of an abscess or the removal of otherwise painful dressings and packs. It is suitable for ambulatory patients because it is rapidly eliminated and is relatively free from postanesthetic nausea and vomiting. Divinyl-ether is usually administered by the inhalation method but may be used with the closed technic. In either case, it is essential that a high concentration of oxygen be supplied and that the drug not be given for longer than 30 minutes to avoid liver damage.[18] In addition to these limitations, one must observe the contraindications which apply to ether.

Nitrous Oxide. When used as the sole anesthetic agent, it is limited in its applicability. It may be used for short, simple procedures not requiring relaxation, such as the incision and drainage of an abscess. Because it is not explosive, it is of value when the cautery is used. It is essential that sufficient oxygen be administered with this agent to avoid anoxia and its serious sequelae. Nitrous oxide is commonly used in conjunction with ether. In concentrations of from 50 to 75 per cent, it may be used advantageously to supplement sodium pentothal anesthesia.

Ethylene. When not in combination with other anesthetic agents, this is open to similar criticisms to those of nitrous oxide. Furthermore, it is explosive. In other respects, it is a very safe anesthetic agent of low toxicity. When general anesthesia is to be used in patients with pre-existing cardiac arrhythmias, ethylene is indicated for the induction of anesthesia which is maintained with ether.

The advantages of ethylene may be enumerated as follows: (1) induction is short; (2) the gas is eliminated without chemical change;[12, 27] (3) the respirations are quiet; (4) muscular relaxation is moderately complete (from 1/3 to ½ that of ether[30]); (5) the gas is not irritating to mucous surfaces; (6) it does not cause postoperative "gas" pains;[33] (7) it may be used satisfactorily in children and in cases complicated by hyperglycemia.

Disadvantages. The fact that ethylene is highly explosive limits its field of use as a routine procedure. The gas is expensive, and special apparatus is required, as well as the services of a skilled anesthetist. Excessive oozing of blood at the site of

operation has been referred to,[42] but, in the author's experience, this has been of little consequence.

Cyclopropane. This agent affords potency, ease of induction and quiet respirations. It is particularly valuable when a high concentration of oxygen is desired. It is a suitable supplement for an inadequate spinal analgesia. In combination with curare, small amounts of cyclopropane produce relaxation comparable to spinal analgesia. Employed in these ways, the author has found this agent of estimable value.

The drug is contraindicated in the presence of cardiac arrhythmias and severe hypertension. It sensitizes the heart to epinephrine by central sympathetic stimulation. An injection of epinephrine during cyclopropane anesthesia may result in ventricular fibrillation.

Sodium Pentothal. This is suitable for some procedures lasting less than 30 minutes. Because pentothal reduces vital capacity, it is contraindicated in the presence of dyspnea, bronchiectasis, cardiac insufficiency, advanced pulmonary tuberculosis and asthma. Some authors[9] report its use as an anesthetic for major surgical procedures. Although we have had little experience in this respect, we do not advocate its use in major surgery as the primary agent. Although the relaxation obtained is fair, we fear the depression that usually accompanies deep pentothal anesthesia.

The chief value of the drug in our hands in abdominal surgery has been as a supplementary[20] or complementary agent used in conjunction with spinal analgesia for the comfort of the patient. When pentothal sodium is used for prolonged periods, oxygen is routinely administered.

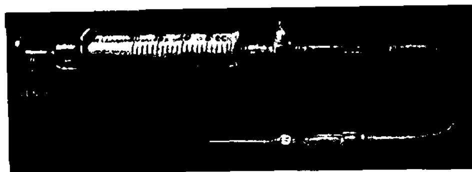


Fig. 683. Apparatus for the administration of intravenous pentothal anesthesia consists of a Luer-Lok syringe, one way stopcock for 1/16-inch bore tubing, 30-inch piece of rubber tubing with 1/16-inch bore, metal adaptor, baketal glass adapter and needle.

Technic of Administration. The apparatus (Fig. 683), for the administration of pentothal sodium consists of a 20-cc. or 30-cc. Luer-Lok syringe and a piece of thick-walled, one-sixteenth-inch bore rubber tubing, 20 inches long. This tubing has a one-way stopcock control which can be attached to the syringe, and at the other end of the tubing is a metal adapter to which a needle can be attached. If the pentothal is to be injected into the infusion tubing, a small-bore needle, 22 or 23 gauge, is placed on the metal adapter and inserted into the tubing close to the large needle, 18 gauge, of the infusion tube. If the solution is to be injected directly into a vein, a special glass adapter is placed between the metal adapter and a 20-gauge or 22-gauge needle.

To prepare the apparatus for administration, the syringe is filled with a two and one-half per cent solution of pentothal sodium, the stopcock of the tubing is connected to the syringe, the needle is attached

to the adapter (metal or glass), and the stopcock is turned off after filling the tubing and the needle.

In our experience, we have found the fractional method of administration very satisfactory. After the needle has been placed in the infusion tubing or directly into the vein, the patient is asked to count aloud, and the solution is injected slowly (about 0.5 cc. per second) until the patient ceases counting. After a transient period of apnea there is usually an inspiratory sigh, followed by a resumption of regular respiratory excursions.

Following induction (cessation of counting), from 0.1 to 0.2 Gm. more is usually needed for surgical anesthesia. Fractional doses of from 0.1 to 0.2 Gm. are added as the patient gives evidence of recovery and awakening. Important points in the administration of pentothal are as follow:

(1) inject slowly and pause frequently to permit maximal circulatory effect and to evaluate the depth of anesthesia; (2) establish and maintain a clear airway to insure adequate oxygen-carbon dioxide exchange; and (3) have apparatus available for the administration of oxygen and artificial respiration.

Curare, also known as "Intocostrin," is a purified *chondodendron tomentosum* extract in aqueous diluent, is available in rubber-capped vials as a sterile solution for parenteral administration, intramuscularly or intravenously, and is supplied in 5-cc. and 10-cc. vials, each cc. containing an amount of Intocostrin equivalent to 20 units.

The drug interrupts nervous impulses to skeletal muscles at the myoneural junction by preventing the acceptance of acetylcholine by the muscle. It blocks the synaptic transmission between preganglionic and postganglionic fibers of the sympathetic nervous system. These inhibitions are reversed by the elimination of curare from the circulation, which occurs rapidly. There is no effect on involuntary or cardiac muscles. It may be given to patients with both kidney and liver damage. Thus far, no evidence of tissue damage in vital organs has been encountered, following its use.

According to various authors and particularly Griffith,[19] curare replaces deep ether for abdominal relaxation, thus reducing postoperative effects.

When curare produces complete muscular relaxation and immobile intestines, respiratory depression or paralysis may occur. Artificial respiration by intermittent manual compression of the rebreathing bag is necessary until normal respiration is resumed. Prostigmine, the physiologic antidote for curare, is administered intravenously in from 1-cc. to 2-cc. doses of a 1:2000 solution.

Although the drug may be used in conjunction with any general anesthetic, it may be most advantageously combined with cyclopropane because of the resulting tendency to prompt recovery and decrease in pulmonary complications. For patients between 20 and 70 years of age, 60 mg. of curare is injected intravenously. Should this amount fail to produce the desired relaxation, a further dose of 40 mg. is injected. Additional doses of 20 mg. may be given at four-minute intervals. Curare is a poison but, when employed intelligently, it is comparatively safe.

TYPES

Regional Analgesia

- (A) Peripheral
  - 1. Freezing
  - 2. Intradermal } Combined
  - 3. Infiltration } Combined
- (B) Conduction
- (C) Extradural—caudal } Sacral or Combined
- (D) Parasacral; transsacral } Sacral or Combined
- (E) Abdominal field block
- (F) Intradural—spinal

REGIONAL ANALGESIA

By regional analgesia is meant the temporary inhibition or arrest of pain sensation to any part or region of the body, effected by obtunding the sensorial impressions at their peripheral distribution, along their conducting pathways or upon their nerve roots. Thus the procedure may be accomplished by analgesizing the nerves at their point of origin, along their course or at their terminal endings. Therefore, the various methods are classified according to the site of injection or application.

Analgesic Drugs

For many years procaine has been the agent of choice for regional analgesia. Recently metycaine has gained wide usage because it produces a more prolonged analgesia. For local infiltration and field blocks, both drugs are used in from 0.5 to 1.0 per cent solution. For nerve blocks, solution of from 1.0 to 2.0 per cent is employed. Physiologic saline solution is used as the solvent; distilled water is hypotonic and may cause pain. Analgesia is induced more rapidly by warming the solution to body temperature at the time of injection. Heating above body temperature must be avoided since it decreases the duration of analgesia and may cause toxic symptoms.

Procaine. Novocain (procaine hydrochloride) is a white, crystalline powder soluble in water, in which it has a neutral reaction, and may be repeatedly sterilized with but slight decomposition. For the purpose of analgesia, the solution should be isotonic. The drug is most effective when injected intradermally, subcutaneously and intraspinally. Ordinarily the drug causes no vasoconstriction, irritation or aftereffects, although fatalities have been known to occur with injections of from 0.01 to 0.14 Gm. of the drug. Babcock reports using 16 ounces of a 1 per cent solution without untoward symptoms. In toxic doses, novocaine accelerates the pulse, causes dyspnea, cardiac palpitation, perspiration, cyanosis, vomiting and mental confusion. As an antidote, such remedies as adrenalin, caffeine, sodium benzoate, atropine, ether inhalation and artificial respiration may be employed to advantage. That the toxic effects of procaine hydrochloride may be prevented has been shown[31, 32] by the administration *per oram* of one of the barbiturate derivatives, given from one-half to one hour prior to the procaine injection.

Pontocaine. Pontocaine hydrochloride is a white powder, freely soluble in water, physiologic saline or spinal fluid, producing neutral solutions which remain stable even after prolonged boiling. It is more powerful and longer-acting than either procaine or metycaine, its potency being approximately ten times as great.

It produces rapid surface analgesia on topical application to mucous membranes and is used by many as a substitute for cocaine. The drug is not used for infiltration anesthesia, its main use being for spinal analgesia.

For topical anesthesia, a solution of from 1 to 2 per cent is employed. For spinal analgesia it is supplied in ampules of 2.0 cc. (1 per cent) each, containing 20 mg. of the agent dissolved in physiologic saline. The solution has a specific gravity of 1.0068, which falls within the average for specific gravity of the spinal fluid (from 1.001 to 1.009).

Woodbridge[45] found metycaine superior to procaine in duration of analgesia and clinically no more toxic, with a record of fatalities better than that of procaine. He also determined that in local infiltration and regional analgesia it becomes effective with greater promptness than procaine.

Nupercaine Hydrochloride. This, also called percaine, is a quinoline derivative, occurring as a white, crystalline powder. It is faintly acid in reaction and does not decompose following repeated sterilizations. By some[17, 29, 43] it is considered more toxic than cocaine and has ten times greater potency. For this reason the strength of the solution for infiltration analgesia is 1:1000

(0.1 per cent),[5] for spinal, 1:1500[22,23] or 1:200, quantity from 1 to 2 cc.; for caudal, 1:1000, quantity from 25 to 35 cc. When given intraspinally, the Trendelenburg position should be used, since the solution has a specific gravity lower than that of spinal fluid.

Quinine and Urea Hydrochloride. This occurs as a white, granular powder or in colorless translucent prisms possessing a bitter taste. It is acid to litmus, is readily soluble and may be boiled without deterioration. Although limited in its use, the anesthetic effect is considered of value for proctologic cases, especially in radical operations for hemorrhoids, fistulae[1] and pruritus ani.[21] The initial injection, using from ¼ to ½ per cent solution, is attended by considerable pain, the anesthetic effect being slow to appear[10] (from five to twenty minutes). Since quinine is a protoplasmic poison, healing of tissue is delayed, and not infrequently necrosis results. Although some patients present an idiosyncrasy to the drug, its true value lies in the fact that the anesthetic lasts for from two to three days, which diminishes postoperative pain by inhibiting the noci-impulses.

According to Werner,[41] quinine and urea hydrochloride is most effective for infiltration and field block analgesia. In all cases, the solution should be freshly prepared prior to use.

(A) Peripheral Analgesia

As the term implies, this denotes absence of pain sensation of the peripheral or terminal nerve endings and may be produced by (1) freezing, (2) intradermal and (3) infiltrative injections, or by a combination of the latter two methods.

(1) Freezing. The field of application of this method is exceedingly limited, and, except to relieve the tension of an acute superficial abscess, the method is seldom employed. Ordinarily, ethyl chloride is used.

(2) Intradermal. With this method, the perianal skin or anal lining is anesthetized by superficial injection using a sharp needle of small caliber. Except when multiple punctures are made at different sites, the procedure is practically painless and, as the solution is introduced, a pale disk or wheal is raised which is insensitive to pain. The method is applicable for the initial step of infiltration and conduction analgesia or where a needle of larger caliber is to be inserted, as in the injection treatment of pruritus ani. It may be used for excision of hypertrophied papillae, crypts, superficial fissures and small condylomatous growths.

(3) Infiltration Method. As usually performed, this consists of free injection and saturation of the tissues immediately adjacent to and beneath the field of operation or just proximal to the sensory nerve endings. In many instances, the nerve terminals are obtunded by pressure rather than by the analgesic effect of the solution. For minor anorectal procedures, such as thrombotic hemorrhoids, inflamed crypts, hypertrophied papillae, fissures or ulcers, this method may be satisfactorily employed.

Combined or Intradermal-Infiltration Method. In this procedure,[30] anesthesia is obtained by making four intradermal wheals about the circumference of the anus, as shown in Figure 684. From these sites the skin around the anus is injected in its entirety. The next step consists in passing a long needle through the wheal and extending the needle between the rectal wall and the external sphincter muscle, at which site the analgesic solution is introduced. If the sphincter is to be paralyzed, the injection is directed into the substance of the muscle. Gant[14] utilized an anterior and a posterior injection, from which the anal margin is anesthetized circumferentially by divergent injections. The tissues are infiltrated until blanched. Deep infiltration is accomplished by inserting the needle at four sites and injecting the solution in the long axis of the bowel.

Disadvantages. Both methods necessitate massive intradermal infiltration, which causes not only local distortion but is attended by considerable discomfort. Such

superficial injections predispose to infection; healing is retarded and relaxation is usually insufficient.

(B) Conduction Analgesia (Nerve Block)

The term is used to imply a procedure in which an earnest attempt is made to analgesize anatomically the conducting pathways to the anorectal area proximal to their terminal distribution by enveloping these pathways with the anesthetic solution, thereby affecting the nerves by diffusion.[23, 29]

In reality, this method may be referred to as extraneural, or paraneural, anesthesia, since the solution is distributed in close proximity to the nerves. Yet, as usually applied, the term denotes injection around the nerve trunks, which, obviously, is not true in this case.

On the other hand, by "field block" is inferred the creation of encircling walls of anesthesia about the field of operation, produced by injecting the solution more or less at random in such a way as to block massively all the nerves to the anorectal area.

The technic of conduction anesthesia is very simple and, if carefully followed, may be performed without distortion of any of the parts, either perceptible or palpable, without pain and with complete muscular relaxation.

Method. The procedure[6] here outlined is identical with that of Werner[44] with but two exceptions, viz., (1) two intradermal wheals are raised in order to minimize the discomfort attending introduction of the large-caliber needle, and (2) the lithotomy position is substituted for the left lateral, since greater tenseness of the perineal and anal raphe is obtained and less assistance is needed by the administrator of the anesthetic solution.

Position. The patient is placed in the exaggerated lithotomy position with the buttocks well over the edge of the operating table and a large pad under the sacral region. A slight Trendelenburg position is effected and a pillow placed beneath the patient's head so that the latter is on a level with the pubis. This adds greatly to the comfort of the patient.

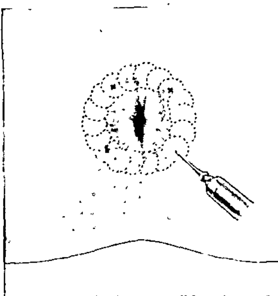


Fig. 684. A line of skin is infiltrated about the anal margin over the anal sphincter (Hertzler: Local Anesthesia, St. Louis, Mosby).

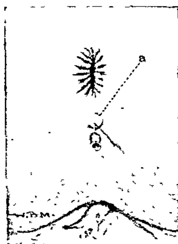


Fig. 685. An intradermal wheal (a) is raised in the midline behind the posterior aspect of the anus. (H. E. Bacon: Surg., Gynec. & Obst. 66:105-108.)

Preparation. In the case of a male subject, a Drueck binder is applied in order to

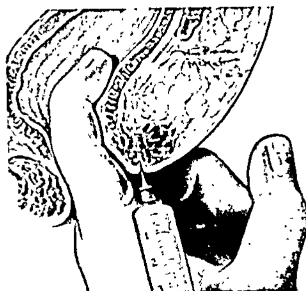


Fig. 686. Sagittal section showing needle inserted in the posterior midline, with finger in the lower rectum as a guide. (H. E. Bacon: Surg., Gynec. & Obst. 66:105-108.)

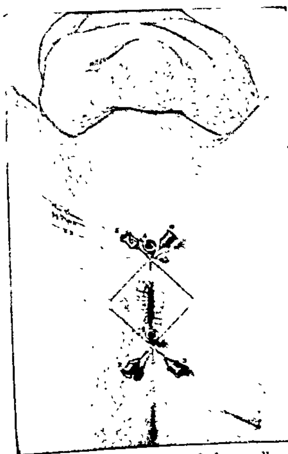


Fig. 687. Appearance of the needles and their direction were then left in place following injection. Needles 1 and 4 run parallel to the anal canal, posteriorly and anteriorly; 2 and 3 provide posterolateral injections; 5 and 6, anterolateral injections. (H. E. Bacon: Surg., Gynec. & Obst. 66:105-108.)

omit the scrotum from the operative field. The anal and perianal skin are then painted with an antiseptic solution.

The Analgesic Solution. Either procaine, 1 per cent, nupercaine, 0.1 per cent (1:000), or metycaine, 1 per cent, may be used, to which is added adrenalin in the proportion of from 2 to 3 drops to the ounce. The solution should be freshly prepared prior to use.

Technic. *Step 1.* With a ¾-inch, 24-gauge hypodermic needle, to which is attached a 2-cc. syringe, an intradermal wheal is produced (Fig. 685) in the posterior midline, approximately ¾ inch behind the anus. Only a few minims of the solution are necessary in order to raise a wheal. It is through this wheal that all three posterior injections are made; their passage is quite painless.

Step 2. A 22-gauge needle three inches long, to which is attached a 10-cc. syringe, is introduced through the wheal and, with the index finger in the anal canal as a guide, the needle is slowly extended parallel and posterior to the canal for a distance of approximately 1½ inches (Fig. 686). Ten cc. of the anesthetic solution are injected at this site; should any discomfort be complained of by the patient, a few minims of the solution may be injected as the needle is advanced. The syringe is detached and the needle withdrawn up to, but not through, the wheal.

Step 3. With the finger in the rectum as a guide, this same needle is slowly inserted on the left side—deeply, forward and outward to the full extent of the needle—depending, of course, on the fullness of the buttocks. The syringe, charged with the solution, is attached, and 5 cc. are slowly injected in this area. The needle is withdrawn as before, up to, but not through, the wheal.

Step 4. The needle is inserted on the right, or opposite, side in the same manner as described for Step 3. Thus, at this stage, the

posterior half has been completely injected by using 10 cc. in the midline and 5 cc. on either side.

Step 5. Using the small hypodermic needle, as in Step 1, the second intradermal wheal is raised in the anterior midline, approximately ½ inch in front of the anus.

Step 6. Again with the finger in the anal canal as a guide, a 2½-inch, 22-gauge needle is introduced through this wheal and gently advanced parallel to the anal canal for a distance of from 1 to 1½ inches, and 10 cc. of the solution are very slowly discharged at this site.

Care should be taken that no bulging is noted, as determined by the finger in the canal and lower rectum. The needle is withdrawn up to but not through the wheal, and Step 7 is then begun.

Step 7. The needle is inserted first on one side.

Step 8. The needle is next inserted in the same manner on the other side—deeply, backward and forward toward the levator muscle for a distance of 2½ inches. In each area, 5 cc. of the solution are injected. This completes the anesthesia (Fig. 687).

The purpose of each step may be described as follows: the two intradermal injections are intended to obtund the skin filaments so as to render subsequent steps with larger needles painless. Step 2 is designed to interrupt the posterior branch-filaments of the inferior hemorrhoidal nerve, the anococcygeal nerves just below their perforation through the sacrotuberous ligament and the perineal branch of the fourth sacral as it pierces the coccygeus muscle. (This branch may be part of the lesser sphincterian nerve—Morestin.)[35] By these posterior lateral injections, the inferior hemorrhoidal nerves are anesthetized at a higher level, together with the perineal nerve and its posterior scrotal or labial branches and the muscular branches of the dorsal nerve to the penis (clitoris in the female). In Step 6, the anterior midline injection inhibits the posterior scrotal nerves—its communicating filaments with the perineal branch of the posterior superficialis muscle. Steps 7 and 8, the anterior lateral injections, affect the terminal branches of the perineal nerve, the muscular branches of the dorsal nerve to the penis (clitoris) and the more anterior branch-filaments of the inferior hemorrhoidal nerve (Fig. 688).

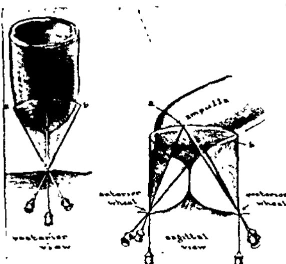


Fig. 688. Posterior and sagittal view of the needles in relation to the anorectal area. (H. E. Bacon: Surg., Gynec. & Obst. 66:105-108.)

Comment. The method is so simple that almost without exception this technic will offer the most excellent results, provided a few salient points are closely followed. Initially, the patient's confidence should be gained and held throughout the procedure; sedation should be given. All injections are made outside the anal canal and rectum, and at no time should the needle penetrate any layers of the wall. No distortion or bulging should be noted either during or following the injection of the anesthetic solution; in fact, the needle itself should be felt only on firm pressure of the guiding finger. Although by Steps 2, 3 and 4 the posterior half will be anesthetized as the injection of the anterior half is completed (Steps 6, 7 and 8), ample time—from three to five minutes—should be allotted for the solution to take effect.

Rationale of Conduction (Nerve Block) Analgesia. Nerve block analgesia



FIG. 689. Position of the patient for a caudal or transsacral nerve block. The patient is prone with a pillow under hips with heels apart.

may be executed with a minimum of discomfort and only slight distortion of the tissues. The resulting analgesia and muscular relaxation are excellent and in duration exceed that following the infiltration method. This technic may be employed for the surgical treatment of internal and external hemorrhoids, rectal prolapse, moderate rectal procidentia, polypi, fissures, simple fistulae, infected crypts, hypertrophied papillae, anal ulcers, condylomata, skin tags and some foreign bodies. It is a suitable method for patients who have a constitutional disease which contraindicates other forms of anesthesia. Nerve block analgesia is better avoided when the extent of the disease cannot be determined prior to operation, when the disease extends above the peritoneal reflection, in the presence of suppuration and for neurotic patients. Other methods of anesthesia or analgesia are preferred for the surgical treatment of sequestration dermoids, stricture of the rectum, extensive procidentia, congenital abnormalities, embedded foreign bodies, massive condylomata, complicated fistulae and malignant tumors.

(C) CAUDAL ANALGESIA

Caudal analgesia (epidural or extradural block). This method involves the injection of a local analgesic agent through the sacral hiatus into the sacral canal where the terminal fibers of the spinal cord below the dural sac are bathed.

The patient assumes a prone position on the operating table (Fig. 689). The sacral area is rendered more prominent by placing a pillow beneath the hips. After preparation of the skin with an antiseptic solution, the tip of the coccyx is palpated with the index finger, which is then moved upward in the midline until a depression is noted which represents the junction of the sacrum with the coccyx (Fig. 690). This depression is triangular in shape, with the apex upward and the base downward. It is formed by the sacral cornua on each side of the midline and the spinous process of the fourth sacral vertebra superiorly (Fig. 691). An intradermal wheal is raised in the center of the triangle. This point is approximately 5 cm. proximal to the tip of the coccyx. Through this wheal the same needle is inserted more deeply, and 1 or 2 cc. of the analgesic solution are injected in order to render the passage of the larger needle less painful (Fig. 692).

With the finger on the spinous process of the fourth sacral vertebra to aid in directing the needle, the 60-mm. caudal needle, with the stylet in place, is introduced through the wheal at an angle of 45 degrees to the skin surface. After penetrating the skin and sacrococcygeal membrane covering the caudal end of the sacral canal, 5 cc. of the analgesic agent are injected. When bone is reached, the needle is slightly withdrawn and the bevel turned ventrally to more readily override the bone.

The hilt of the caudal needle is depressed and reinserted (Fig. 694a) at an angle of 20 degrees to the surface of the skin of the sacral region. After inserting the needle for a short distance, it is rotated 180 degrees, causing the bevel to face dorsally. The point of the needle should not be inserted higher than the level of the second sacral foramen. To avoid intravascular or intradural injection, gentle aspiration is practiced with the bevel of the needle turned both upward and downward. If neither blood nor spinal fluid are obtained, 20 cc. of the analgesic solution are injected slowly. Should aspiration yield blood, the position of the needle is changed before injection is accomplished. In the event of spinal fluid being obtained upon aspiration, the point of the needle is withdrawn from the dural sac and from 5 to 10 cc. of the analgesic solution injected. Further analgesia must be obtained by transsacral block.

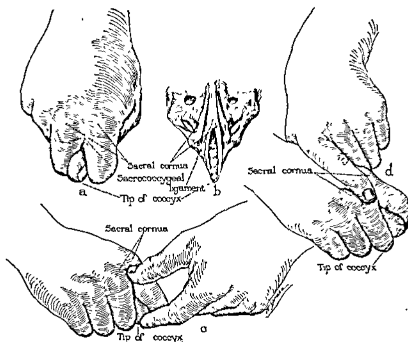


Fig. 690. Manual teaching exercise showing how the sacral hiatus is palpated. Extend the right thumb well through between the fully flexed first and second fingers of the right hand (a). Turn the back of the right hand upward. Palpate the tip of the right thumb with the tip of the index finger of the left hand (c); with the tip of the left thumb palpate the niche between the proximal ends of the proximal phalanges of the first and the second fingers of the right hand (c), the tip of the thumb resting slightly distal to the knuckles of the right hand (metacarpophalangeal articulations of the index and middle fingers). When this spot is noted, the first maneuver is complete. In the second maneuver, bring the palmar surface of the left index finger to rest on the back of the right hand over the space between the second and the third metacarpal bones (d). With the tip of the index finger palpate the niche between the knuckles of the index and the middle fingers and slightly beyond. While so doing, slowly extend the index and the middle fingers of the right hand; as they go from full flexion to full extension the palpable niche becomes quite shallow. Thus most of the sensations usually experienced in palpating the sacral hiatus are transferred to the tip of the left index finger. The knuckles represent the two sacral cornua; the web between the fingers represents the sacrococcygeal membrane, (a) and (b). The point palpated in the first maneuver by the tip of the thumb (c) and in the second by the tip of the index finger (d) represents a point overlying the entrance to the caudal canal. (J. Lundy: J. Urol. 17:525.)

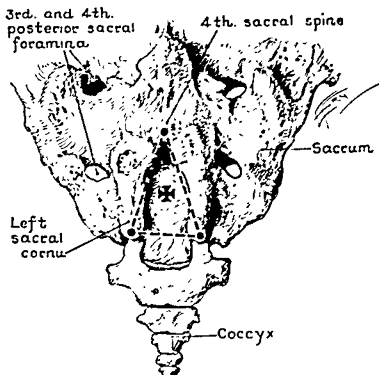


Fig. 691. The cross denotes the site of the puncture through the sacral hiatus bounded by a triangle formed by joining the sacral vertebra. (Labat: Regional Anesthesia, Philadelphia, Saunders.)

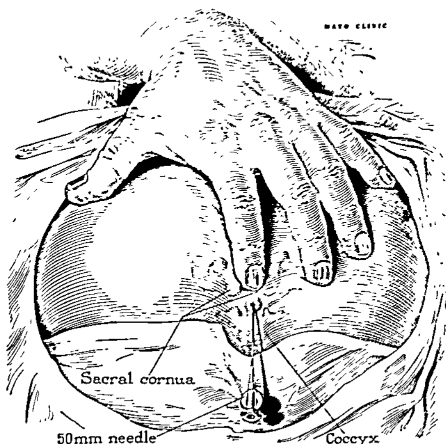


Fig. 692. After identification of the sacral cornua, the needle is inserted through the sacrococcygeal ligament into the mouth of the caudal canal. (Rankin, Bargen and Buie: Colon, Rectum and Anus, Philadelphia, Saunders.)

During injection, the posterior surface of the sacrum is palpated to detect swelling which occurs when the injection is made posterior to the sacrum rather than in the caudal canal.

to inject the second foramen first. If it is not readily found, the third or fourth are injected, since the location of one foramen facilitates finding of the others (Fig. 694 c).

The needle is first advanced until it

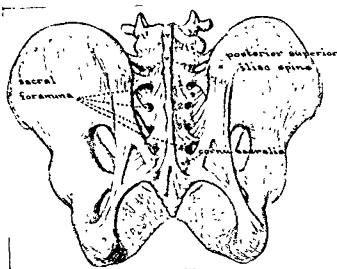


Fig. 693. Transsacral analgesia. The sacral foramina are shown. The entrance to the caudal canal may be noted mediad and just below the sacral cornu.

Early signs of a successful caudal block, parasthesias in the region of the legs or thigh, a sensation of pressure in the sacrum or coccyx, are elicited. The needle is retained in the canal while a transsacral block is performed.

(D) Transsacral Analgesia

Synonyms: transsacral, parasacral, or postsacral, nerve block.

A transsacral block is accomplished by injecting an analgesic agent into the second, third and fourth sacral foramina bilaterally. The foramina lie along a line approximately one finger's breadth lateral to the midline of the sacrum. The second sacral foramen is found at a point about one finger's breadth caudal and medial to the posterior superior iliac spine (Fig. 693). The third and fourth foramina lie one and two finger breadths below the second, respectively. Wheals are raised over the approximated sites of the foramina. An attempt is made

strikes the sacrum. This depth is measured roughly on the needle in order that it may be stopped when it has merely entered the foramen.

For the average person, the following amounts of a 1 per cent solution of metycaine or procaine are injected bilaterally: from 10 to 12 cc. in the second foramen; from 5 to 10 cc. in the third foramen, and 5 cc. in the fourth sacral foramen. Following these injections, 10 cc. of analgesic solution are introduced into the caudal canal. In the event that a needle cannot be placed in the caudal canal, twice the usual amount of analgesic solution is injected in the sacral foramina.

Before any injection is made, careful aspiration is practiced to detect blood or spinal fluid. Should either be obtained, the position of the needle is changed slightly until aspiration yields neither. Should toxic symptoms occur, the injections are interrupted and resumed cautiously.

Analgesia extending to the lower rectum, anus, perineum, bladder, scrotum and penis appears within 15 minutes and lasts for from one to two hours. It is ideal for many anorectal operations. The margin of safety is greater than with intradural analgesia.

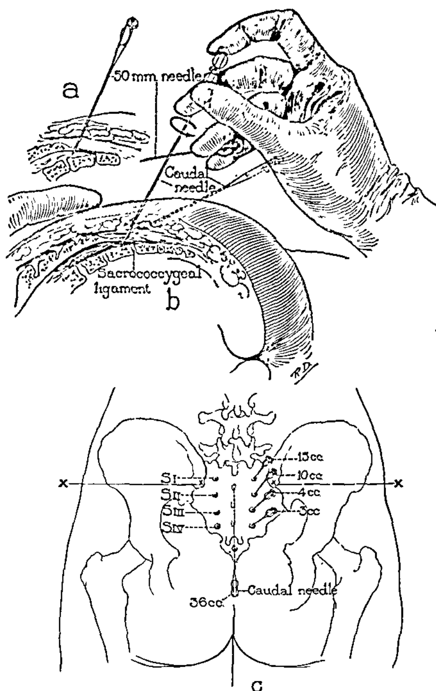


FIG. 694. *(a) A 50-mm. needle is inserted through a wheal over* the sacrococcygeal membrane into the tip of the caudal canal, and 5 cc. of the solution is injected to make the insertion of the caudal *needle painless. (b) The 50-mm. needle is withdrawn,* and the caudal needle is inserted in its stead. This is advanced after being rotated so that the bevel rests on bone. (c) Dorsal view of the sacrum with *caudal needle* in position as well as those in SI, SII, SIII, and SIV (first, second, third and fourth foramina). (J. Lundy: Clinical Anesthesia, Philadelphia, Saunders.)

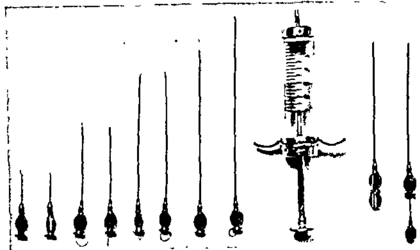


FIG. 695. Labat's sacrocaudal outfit. On the right are shown two caudal needles. (Pilling and Co.)

When caudal analgesia is not supplemented by a transsacral block, there is a failure in a small percentage of cases.

(E) REGIONAL ANALGESIA FOR ABDOMINAL SURGERY

Abdominal field block induces analgesia of the entire thickness of the abdominal wall (Fig. 696). Because the procedure is painful, it is best performed after a light general anesthesia has been obtained by the administration of sodium pentothal or cyclopropane.

A skin wheal (a) is made one centimeter below the xiphoid process. Another wheal (b) is made at the level of the tenth costal cartilage, where the lateral margin of the rectus muscle crosses the costal arch. A third (c) and fourth (d) wheal are made along the lateral margin of the rectus muscle, one inch above and two inches below the level of the umbilicus. An eight-cm. needle is passed through the first wheal (a) and directed laterally along the costal border where intradermal and subcutaneous injections of the analgesic agent are made. The needle is partially withdrawn and redirected obliquely until the rectus sheath is penetrated. In this manner, four injections of two cubic centimeters each are made at intervals of two centimeters into the rectus muscle. Similar injections are made through the second, third and fourth wheals directing the needle along the lateral

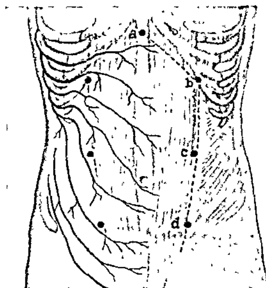


FIG. 696. Abdominal field block. Point (a) shows the site of wheal at the xiphoid process; (b), (c) and (d) mark the wheals along the lateral margin of the rectus muscle and sheath. The broken line shows the subcutaneous and intramuscular infiltration. In this procedure there are eight of the units shown. (Redrawn from Labat.)

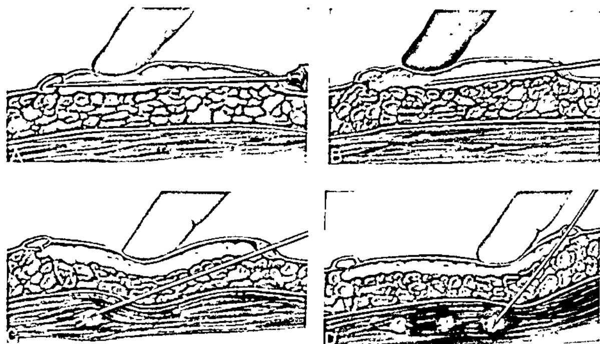


Fig. 697. Abdominal field block showing the subcutaneous and intramuscular infiltration. At the end of a subcutaneous line of injection a wheal is raised from below. The left forefinger is then moved back 2 cm. (A) The point of the needle is withdrawn until it is felt beneath the forefinger; (B) it is thrust through the fascia, and 2 cc. of solution is injected (C). This maneuver is then repeated three times (D). (Redrawn from Woodbridge: Canad. M. A. J. 38:216.)

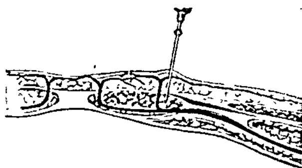


Fig. 698. Cross section of the anterior abdominal wall showing the position of the needle for deep muscular infiltrations within the rectus sheath. This section of the abdominal wall is between points (B) and (D), as shown in Figure 697. The heavy black lines are the intercostal nerves, which terminate in the anterior abdominal wall and are blocked in the rectus sheath.

border of the rectus muscle. Such an abdominal field block results in analgesia in the distribution of the seventh through the eleventh thoracic nerves on one side of the abdomen. The same procedure may be repeated on the other side of the abdomen for a bilateral block (Fig. 699).

The duration of the analgesia resulting from an abdominal field block is usually an hour. This method is suitable for colostomy of the transverse colon. An abdominal field block performed on the left side of the abdomen provides suitable analgesia for a left rectus colostomy.

(F) Spinal Analgesia

Synonyms are intradural anesthesia, intraspinal block,[41] rachianalgesia[4] and medullary narcosis.

Intradural, or spinal, analgesia may be defined as an extensive nerve block produced by injecting a local analgesic into the subarachnoid space, which, by diffusion with the cerebrospinal fluid, results in regional loss of sensation. As Babcock[2] states: "In no other way can so extensive an analgesia

be produced with as small a dose of a drug."

Spinal analgesia, when properly selected and administered, permits greater safety than where a general anesthetic is used, for, as has been shown,[8] its mortality and morbidity compare favorably with other types of anesthesia.[11, 15, 16]

Pioneers in surgery[21, 37] early realized the value of this method in anorectal operations, and because of its quick administration and the excellent relaxation it afforded, made it preferred by many to other procedures.

For the past eighteen years all patients have been carefully evaluated as to the selection of anesthesia, yet in the vast majority of instances, in fact almost routinely, spinal analgesia is employed as the procedure of choice.

Anatomy. The spinal cord, or medulla spinalis, ends at the upper border of the second lumbar vertebra in a conical extremity known as the conus medullaris and is continued downward as a bundle of lumbar and sacral nerves collectively termed the cauda equina. These nerves float freely in the cerebrospinal fluid which is contained in the subarachnoidean space. Thus, when an analgesic solution, such as novocaine, is injected into this space, it immediately diffuses with the spinal fluid and, by bathing the motor and sensory nerve roots,[3, 13] causes an analgesia in the body areas supplied by the nerves derived from and below the level of injection.

The cerebrospinal fluid has a specific gravity ranging from 1.004 to 1.007, so that the specific gravity of the analgesic solution and the position of the patient must be carefully considered, because the cerebrospinal fluid communicates with the general ventricular cavity as well as the roots of several cranial nerves. For example, solutions of lighter specific gravity than that of the cerebrospinal fluid will diffuse upward with the patient in the sitting posture, and likewise will soar downward if the patient's head is lowered.

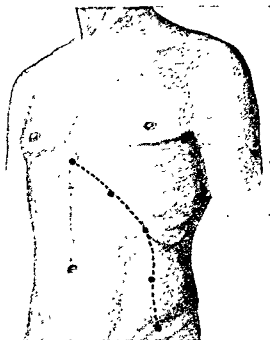


Fig. 699. Abdominal field block for sigmoidostomy. Dots show where skin wheals are raised from xiphoid process along the costal margin to the tip of the eleventh rib then to the iliac crest. The broken line shows the subcutaneous and intramuscular infiltration.

Drugs. Procaine and Metycaine. Procaine and metycaine may be used to induce spinal analgesia and are supplied in ampules containing 2 cc. of a 10 per cent solution (200 mg.). With the patient in the lateral decubitus position, the skin in the region from the second to the fourth lumbar vertebrae is prepared with an antiseptic solution. The chosen interspace is infiltrated with a 1 per cent solution of procaine or metycaine containing 48 mg. of ephedrine sulfate. With a Sise introducer in place, a lumbar puncture is made with a 20-gauge, 21-gauge or 22-gauge spinal needle. The calculated dose of procaine or of metycaine is aspirated from an ampule into a 5-cc. syringe. Enough spinal fluid to obtain the desired solution is aspirated into the same syringe, and the mixture is immediately injected intrathecally at the rate of 0.5 cc. per second. The patient is quickly turned to the prone position.

TABLE 89. DOSAGE

Procaine or Metycaine, 10 Per Cent, in Spinal Fluid or Normal Saline (Hyperbaric)				
Anesthesia of the	*Dose*	*Diluted with Spinal Fluid or Saline (Volume)*	*Site of Injection*	*Position of Table*
Perineum	40-80 mg. (0.4-0.8 cc.)	2 cc. average (1.5-3.0 cc.)	Lumbar 4	Level
Lower abdomen	80-140 mg. (0.8-1.4 cc.)	4 cc. average (3-5 cc.)	Lumbar 3	10 degrees Trendelenburg until anesthetized
Upper abdomen	150-200 mg. (1.5-2.0 cc.)	4-5 cc.	Lumbar 2 or 3	10 degrees Trendelenburg until anesthetized to the desired level

Since the injected solution is heavier than spinal fluid, the analgesic solution may be made to flow cephalad or caudad by gravity during the first 15 minutes following injection by altering the position of the table.

In this manner, the desired level of analgesia may be obtained. To prevent the analgesic solution from reaching the medulla, the head of the patient is flexed on the thorax by means of a pillow. When the desired level of analgesia is obtained, the table is placed in a horizontal position.

Analgesia is usually obtained in from three to eight minutes. Twenty minutes following injection, the analgesic solution is fixed in the tissues and is unaffected by gravity. The patient may then be placed in any position desired by the operator.

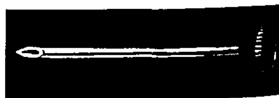


FIG. 701. Sise introducer.

Metycaine produces analgesia which lasts an hour or an hour and a half. The duration of the analgesia produced by this drug is approximately 40 per cent longer than that produced by procaine. Furthermore, after metycaine muscular rigidity returns more slowly than following procaine, a fact that

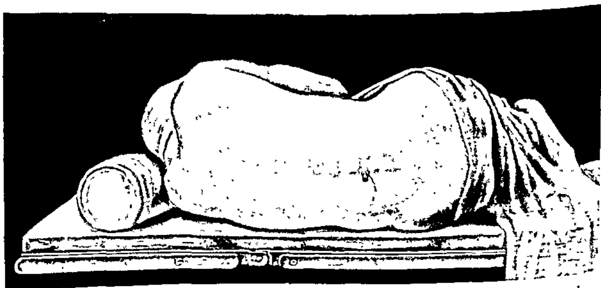


FIG. 700. Position of patient for spinal puncture when using pontocaine-dextrose. A hard pillow is used to keep the head elevated.

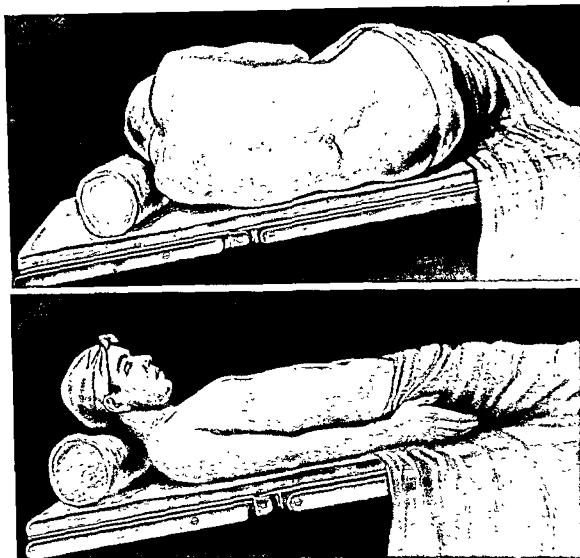


FIG. 702 A. (A, *Top*) Patient in position, 10° Trendelenburg, for injection of pontocaine-dextrose solution into the subarachnoid space. Head elevated by hard pillow.
FIG. 702 B. (B, *Bottom*) Position of patient after the subarachnoid injection—on back, in 10° Trendelenburg, and hard pillow to keep head elevated. This is the position for obtaining height of anesthesia, after which the table is leveled.

facilitates supplementing the spinal analgesia with anesthesia.

PONTOCAINE AND DEXTROSE. Spinal analgesia of long duration may be induced by a mixture of pontocaine and dextrose.[36, 38, 40] After preparing the skin surface in the lumbar area with an antiseptic solution, both skin and interspinous ligament of the chosen interspace is infiltrated with a local anesthetic (Fig. 702) solution containing ephedrine sulfate, 48 mg. The table is placed in a 10° Trendelenburg position and the patient's head elevated by a pillow or sand bag. Spinal puncture is accomplished with a 22-gauge needle. The previously determined dose of a 1 per cent solution of pontocaine thoroughly mixed with one and one-half times its volume of 10 per cent dextrose solution is injected at the rate of 0.25 cc. per second. Immediately following

the injection, the patient is turned on his back and the level of analgesia is determined.

Because the injected solution is hyperbaric, the analgesia may occasionally reach dangerous heights during the minute the patient is in the Trendelenburg position. To prevent analgesia of the cervical and upper thoracic areas, the head must be kept elevated at all times during the induction. Should the analgesia rise too high, placing the patient in a 5° Fowler position will tend to check the rise. Usually when the patient is returned to the dorsal decubitus position following injection and kept in a horizontal position, the level of analgesia reaches the sixth or seventh thoracic segment in one minute and the fourth or fifth in three minutes. Should the analgesia fail to rise to the desired level, the patient may be returned to the 10° Trendelenburg position until the desired height is obtained.

For patients who are to be operated on in the Trendelenburg position, the intrathecal injection is made in the third or fourth lumbar interspace with the patient placed in a 10° inclination. This position is maintained for one minute, after which the patient is immediately tilted into a 5° Fowler position for two or three minutes. The patient may then be placed in the Trendelenburg position, but the level of analgesia must be carefully checked and the patient observed for evidence of intercostal paralysis.

For anorectal operations, where the so-called "jackknife" position is used (Fig. 710), the injection is made in the fourth lumbar interspace with the patient in a horizontal position. One cc. (10 mg.) of a 1 per cent solution of pontocaine mixed with 1 cc. of a 10 per cent solution of dextrose and 1 cc. of spinal fluid, is the usual dose. Immediately following the injection, the patient is placed in a prone position for three minutes and the level of analgesia determined. Rarely does the analgesia rise above the twelfth thoracic segment. At the termination of the three-minute period, the patient may be placed in the jackknife position. A frequent determination of the height of analgesia must be made.

The dose of pontocaine is obviously a matter of judgment involving many factors. In determining the proper dosage, the novice will find a table of dosage reported by Sise to be of value (Table 90).

These amounts will produce from 1½ to 2 hours of analgesia. For a single injection, 20 mg. of pontocaine should never be exceeded.

NUPERCAINE. Before Lemmon[25] intro-

TABLE 90. MODIFICATION OF SISE'S TABLE FOR DETERMINING DOSAGE OF PONTOCAINE FOR SPINAL ANESTHESIA IN ADULTS

ANESTHESIA OF THE	PONTOCAINE 1%	DEXTROSE 10%	SITE OF PUNCTURE	POSITION OF TABLE FOR INJECTION
Anus	10 mg. (1.0 cc.)	1 cc. dextrose plus 1 cc. spinal fluid	Lumbar 4	For inverted, or jackknife, position, inject with patient level; place on back for 3 minutes then in jackknife position
Lower extremities				
Perineum, external genitalia, bladder	10 to 14 mg. (1.0 to 1.4 cc.)	1.5 to 2.1 cc.	Lumbar 4	Level to 5 degree Fowler for from 1 to 2 minutes with head elevated
Lower abdomen	10 to 18 mg. (1.0 to 1.8 cc.)	2.0 to 2 5 cc.	Lumbar 3	10 degree Trendelenburg position for 1 minute with head elevated
Upper abdomen	14 to 20 mg. (1.4 to 2.0 cc.)	2.6 to 3.0 cc.	Lumbar 2 or 3	10 degree Trendelenburg for from 1 to 1½ minutes with head elevated

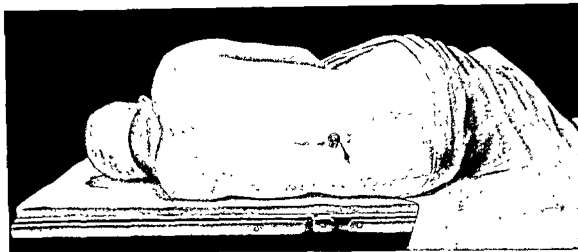


Fig. 703. Position of patient for subarachnoid injection of nupercaine. No pillow used under head.

duced his method of continuous spinal analgesia, nupercaine was frequently employed. It is still preferred by some where an early, steep Trendelenburg position is required. The dosage is based on the factors involved and depends upon the judgment of the anesthetist. A dilution of 1:1,500 is employed.

For operations on the lower abdomen and lower regions, the dose is determined by dividing 100 by the number of the upper thoracic segment which is to be anesthetized. The quotient is the amount in cubic centimeters of nupercaine solution to be used.

For operations in the upper abdomen, the sex and height of the individual control the dosage of the nupercaine solution. For a woman five feet in height, 16 cc. are used; for a male of similar height, 17 cc., then 1 cc. of solution is added for every three inches over five feet. The total dose should never exceed 20 cc. of the solution.

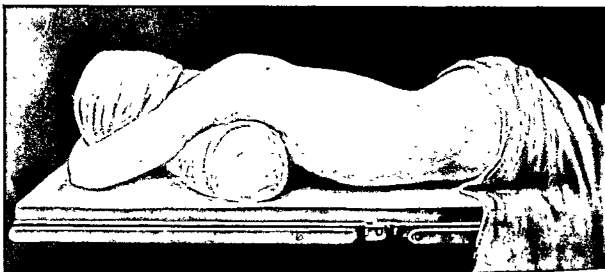
Technic. The ampule of nupercaine and a 20-cc. syringe are warmed to body temperature. Since the drug precipitates in the presence of an alkaline medium, it is necessary to have an acid reaction.

The nupercaine, as supplied, is slightly acid, and 1 cc. is sufficient to rinse out the syringe and needle. This 1 cc., used for rinsing, is then transferred to a 3-cc., 3-ring, Luer-Lok syringe, to which is added a small amount of physiologic saline and 48 mg. of ephedrine.

This is used for the local infiltration of the lumbar puncture. This puncture is made with a 20-gauge needle, using the Sise introducer to pierce the skin and interspinous ligament. For upper abdominal analgesia, the selected site is the second lumbar interspace, with the patient lying in the lateral decubitus position (Fig. 703).

After the tap is made, 5 cc. of spinal fluid are withdrawn and discarded. Because of the large volume of solution to be injected, this may lessen the tendency to headache. The warm nupercaine solution is then injected not faster than 0.5 cc. per second. Following completion of the injection, the patient is immediately placed in a prone position with the head flat. For lower abdominal operations, the patient may be kept level in the prone position or in a slight Trendelenburg position for a few minutes; thereafter, the table may be tilted into a steeper Trendelenburg position.

For adequate analgesia in upper abdominal operations, the height should reach to a level between the second and fourth thoracic segments. To make the light nupercaine



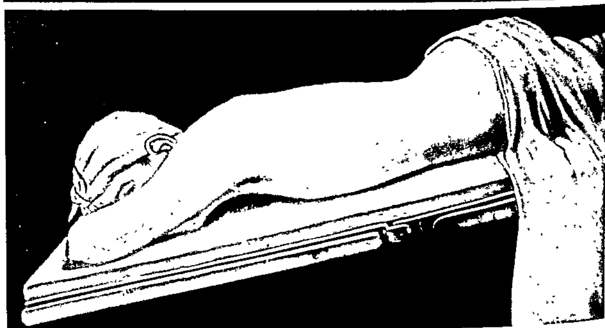


Fig. 704. (*Top*) Position of patient after hypobaric solution of nupercaine has been injected into the subarachnoid space. Pillow is placed under sternum to obtain the desired height of anesthesia.

Fig. 705. (*Bottom*) Position of patient after obtaining the desired height of anesthesia. The lift under the sternum is removed before turning the patient supine.

solution proceed cephalad to the desired position in the spinal canal, a special lift under the upper portion of the patient's sternum is used to raise this area to a 15° angle in a horizontal plane, or approximately eight inches (Fig. 704). Care must be taken to keep the patient's head lower than this thoracic area. In so doing, since the solution is lighter than the spinal fluid, it will flow to and settle in the highest region of the spinal canal, which, in this position, is about the level between the second and fourth thoracic segments. This prevents the solution from running to the cervical roots and the medulla because these important points are lower, and a light solution will not proceed downhill. Since many operating tables are not equipped with special lifts, we have had to use a second method, which has proven just as satisfac-

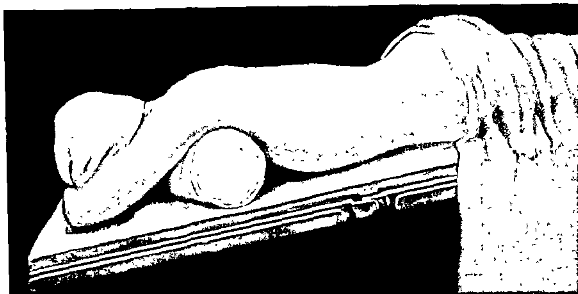


FIG. 706. Position of patient after obtaining the desired height of anesthesia. The table is tilted from 5° to 10°, Trendelenburg position, before the pillow is removed from under the sternum.

tory. The patient is placed prone, following the injection, with head and arms over the end of the table, which is then tilted from 10° to 15°, Fowler position (Fig. 707). Care is taken that the patient's head and cervical region are always lower than the upper thoracic level. The level of anesthesia is tested with a clamp within two minutes from the start of the injection. It usually requires from three to twelve minutes for analgesia to develop to the desired level.

When this phase has occurred, the table is tilted to from 5° to 10°, Trendelenburg position, and then the special lift under the sternum is lowered (Fig. 706). Under no circumstances is the patient returned to a supine position before the Trendelenburg position is assumed. This precaution prevents cephalad rise of the anesthesia; it should be stressed again that the head is to be kept lower than the shoulders. Rarely does the level travel more rapidly or higher from two to four minutes after the start of the injection procedure. In any event, it is essential to be alert for these rare occurrences by early and frequent testing.

Should this ever be encountered, the patient is to be immediately tilted to a 10° Trendelenburg position, leaving the patient in the same prone position for approximately ten minutes. This procedure insures complete bathing of the sensory root nerves by the light analgesic solution and also causes this hypobaric solution to flow away from its extended position, so that when the patient is turned on his back, the motor roots will not be affected in the higher regions.

In the event of a severe fall in blood pressure and pulse rate, associated with unconsciousness due to cerebral anemia as a result of position, the patient is immediately placed in the Trendelenburg position and in a supine posture.

Oxygen is administered by mask, intravenous fluid and a cardiovascular stimulant (ephedrine, 25 mg., plus pitressin, 5 units) given intramuscularly or from two to three minims of this combination intravenously.

PROCAINE TECHNIC FOR MINOR ANORECTAL OPERATIONS. Qualified anesthesiologists now enjoy their rightful place in many of the larger hospitals, and it is hoped

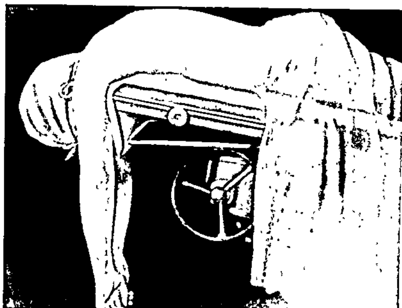
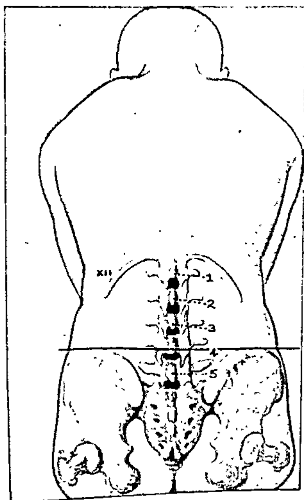


FIG. 707. Another position for obtaining height of anesthesia after nupercaine has been injected. Patient is placed prone with head and arms over the end of the table and the table tilted from 10° to 15°, Fowler position.



that, ere long, these specialists will be a requirement for all hospitals. Since 1930, the author has employed the Babcock technic for anorectal operations and, although not popular with many anesthetic departments, it has proved extremely satisfactory in our hands. In over 9,000 personal administrations, no death has occurred, and no complication other than headache (7 per cent, and later on 3 per cent) and urinary retention (7.1 per cent) has been encountered.

Technic. A sterile towel is stretched smoothly across the previously prepared back so that its upper edge is on a line with the posterior-superior aspects of the iliac crest (Fig. 708). In the midline, the edge

FIG. 708. Posterior view of patient showing the relation of the iliac crest to the interspaces and spinous processes. A line drawn from one iliac crest to the other crosses the spinous process of the fourth lumbar vertebra. The fourth lumbar interspace is immediately below and is the most usual site of injection for low rectal operations under spinal analgesia.

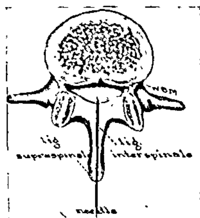


Fig. 709. Cross section of vertebra showing needle in the spinal canal.

of the towel crosses the spine of the fourth lumbar vertebra. The interspace immediately below (the fourth) is carefully palpated and indented with the thumbnail. A wheal is made with a few minims of procaine solution. Using a No. 25 hypodermic needle attached to a 2-cc. syringe containing 0.5 cc. of a 1 per cent procaine solution, a wheal is produced in the indented skin. The needle is slowly inserted, keeping steady pressure on the plunger of the syringe so that the needle point follows the advance of the analgesic solution, thereby producing a minimum of discomfort to the patient by analgesizing the supraspinous and interspinous ligaments. The hypodermic needle is withdrawn, and a 22-gauge, shaft-beveled, spinal needle is introduced firmly and gently in the midline perpendicular to the skin surface. The needle is inserted directly forward with slight rotation until the dense intraspinous ligament is felt when the stylet is removed (Fig. 709).

Advancement is slowly continued until the dura is punctured, which imparts a click or snap to the trained finger. The fluid should be clear and should drop freely. Approximately five drops more than the amount of solution to be injected are permitted to escape. If the fluid does not flow freely, the needle may be gently rotated, slightly withdrawn or slightly advanced. In all cases, this should be performed without the stylet in place. The syringe containing the analgesic solution is attached tightly to the needle. The plunger is withdrawn to the 2-cc. mark, and the analgesic solution is

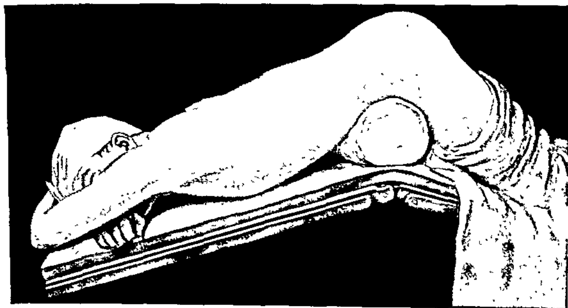


Fig. 710. Patient in a jackknife, or inverted, position for rectal operation after spinal anesthesia has been given.

slowly and carefully admixed with the spinal fluid. Thorough dispersion in this manner is absolutely essential, especially when small doses are employed. The spinal analgesic solution having been slowly introduced in its entirety, the needle is quickly withdrawn in an effort to preclude any leakage through the dura. Where this hypobaric solution is employed, the patient is placed on the abdomen in the jackknife position within 20 seconds (Fig. 710).

The solution employed, which we have designated as the "Babcock solution," is 8 per cent procaine with alcohol. It is therefore hypobaric. Ordinarily, from 80 to 100 mg. of solution are used.

Fractional or Continuous Spinal Analgesia. Anesthetists are now better equipped to administer spinal analgesia for an indefinite period of time by the fractional, or continuous, technic introduced by William T. Lemmon.[26] This method is simply a means of injecting, in fractional doses, an analgesic solution as needed during the course of an operative procedure. It is accomplished by keeping a spinal needle in the spinal canal throughout the time of operation, and, by means of a syringe connected to the needle, additional doses may be administered from time to time at the discretion of the operator.

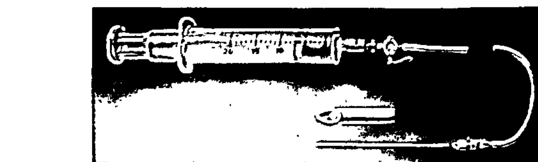


Fig. 711. Equipment for fractional spinal anesthesia. A 20-cc. Luer-Lok syringe, one way stopcock, a piece of rubber tubing 30 inches long with 1/16-inch bore, Luer-Lok adapter for needle and malleable silver needle with hole in bevel.

Equipment. A 20-cc. syringe with Luer-Lok tip connected to a 30-inch, thick walled, 1/16-inch bore rubber tubing by means of a one-way Luer-Lok stopcock is employed. The opposite end of the tubing has a Luer-Lok connection for the needle. The needle used is three and one-half inches in length, either 18-gauge or 19-gauge, and made of malleable German silver which has a small hole in the bevel facilitating aspiration of spinal fluid.

Another important part of the equipment is the mattress in two pieces covered with rubberized material. It is 6 feet long, 15 inches wide and 5 inches thick, with a cut-out section, 7 inches long, beneath the lumbar area, so that when the patient is on his

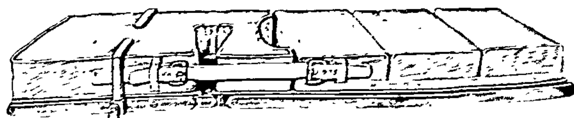


Fig. 712. Mattress used for fractional spinal anesthesia.

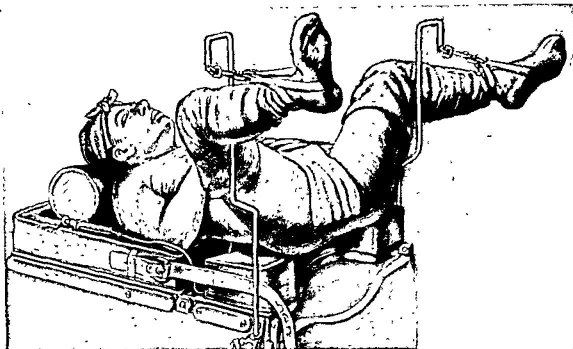


FIG. 713. Patient in lithotomy position for rectal surgery (perineal excision and resection) using fractional spinal anesthesia. The lower part of the mattress is removed. The limbs in this illustration are incorrectly suspended. They should be elevated and flexed well on the abdomen, assuming the Young's position as if for perineal prostatectomy.

back, the indwelling needle does not touch the mattress or the table. The lower section of this mattress is removed when perineal operations are performed. The lower part of the upper end of the mattress has a rounded, cut-out portion to facilitate operations on the anorectum with the patient in the lithotomy position (Fig. 713).

AGENTS. Various agents and methods for fractional spinal anesthesia have been used. The most common in use are procaine, metycaine, pontocaine and nupercaine. Lemmon, in his original work on fractional spinal analgesia, used procaine, 10 per cent, in spinal fluid. Since then he has reported using a 5 per cent solution of procaine.

THE TECHNIC. That which we have found to be most satisfactory is the one using a pontocaine-dextrose solution, the concentration being approximately 0.3 per cent pontocaine in 7 per cent dextrose. This solution is prepared by mixing 4.5 cc. of 1 per cent pontocaine with 10.5 cc. of 10 per cent dextrose. Before the spinal tap is made, the syringe, containing 15 cc. of the analgesic solution, is attached to the 30-inch rubber tubing with a capacity of 2 cc. The tubing is filled, leaving 13 cc. still in the syringe, and the stopcock is closed.

The patient is placed in a lateral decubitus position so that the back of the patient



FIG. 714. Moore introducer serves as a grooved director to insert fractional spinal needle. After the needle is in place, the introducer can be removed without disturbing the needle.

is toward the side of the mattress with the cut-out opening for the tube. After the back has been prepared and draped, 48 mg. of ephedrine sulfate are injected, together with a local analgesic solution (pontocaine) in the interspace selected for the lumbar puncture. The interspace used is the second lumbar for upper abdominal, and the third lumbar for lower abdominal procedures. A Moore[34] introducer (Fig. 714) is used to puncture the skin and interspinous ligament and also serves as a grooved director through which the needle may be inserted. The introducer is removed after the needle is in place without disturbing it. After the puncture is made with an 18-gauge malleable German silver needle and the spinal fluid flows freely, the previously prepared syringe and the tubing containing the analgesic solution is attached to the indwelling

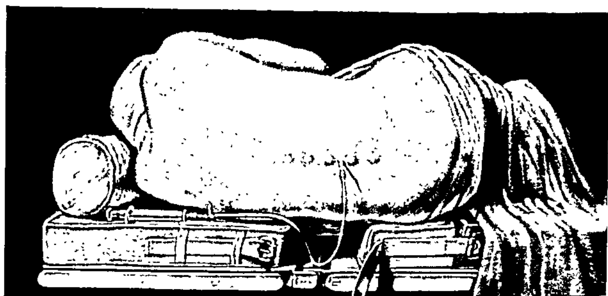


Fig. 715. (*Top*) Position of patient in left lateral position on fractional spinal mattress; the malleable needle is in the spinal canal, and the syringe and the tubing are connected.

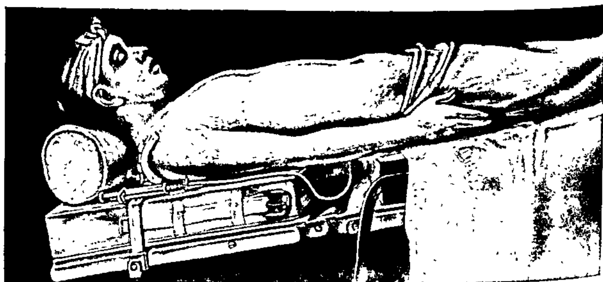


Fig. 716. (*Bottom*) Position of patient with malleable needle in the spinal canal for fractional spinal anesthesia. The patient is placed supine and then in the 10° Trendelenburg position before injection of the pontocaine-dextrose solution.

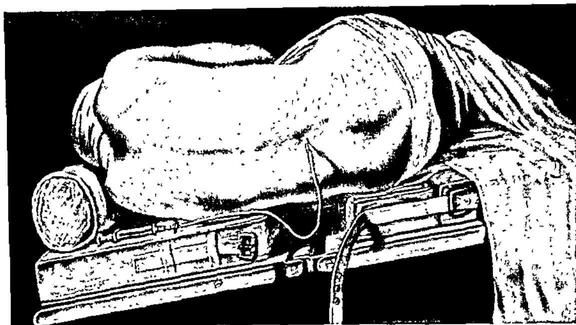


Fig. 717. Position of patient with fractional spinal equipment and needle in situ placed in 10° Trendelenburg for injection of pontocaine-dextrose. Following injection the patient is turned supine.

needle. This system of syringe, tubing and needle is tested to make certain that a free flow of spinal fluid can be obtained. Inability to aspirate usually means that the needle is not in the spinal canal.

After a free flow of spinal fluid is established, the spinal fluid aspirated is expelled from the tubing, thereby refilling it with the analgesic solution. Then the stopcock is closed to prevent aspiration of spinal fluid while the patient is being placed in position.

With this system still connected and the needle remaining *in situ* (Fig. 715), the patient is turned with great care to the supine position, so that the needle is in the center of the cut-out section. The patient's head is raised, as was previously described in the pontocaine-dextrose technic, to prevent cephalad rise by the effect of gravity. The syringe is fastened to the mattress at the side of the patient's head, making it handy for subsequent doses. Shoulder braces are of assistance, as they prevent sliding of the patient or mattress during any part of the procedure, should the Trendelenburg position be used.

To induce spinal analgesia with 0.3 per cent pontocaine and seven per cent dextrose solution, the patient is tilted 10 degrees in the Trendelenburg position, and 5.0 cc. (15 mg.) of this solution are injected at the rate of 0.25 cc. per second without barbotage. As this mixture is heavier than spinal fluid, the height of anesthesia is obtained by gravity. The patient is kept in the 10° Trendelenburg position (Fig. 716) until the analgesia reaches within two segments of the desired height, or for not more than three minutes. The height is usually reached in one, two or three minutes. We have found one minute and ten seconds to be adequate for almost all cases. It is again stressed to be sure that a four-inch lift is used to flex the head. When the desired height is reached, the patient is leveled.

Although many anesthetists usually dilute the remaining solution with spinal fluid or saline for subsequent injections, we have obtained better results by using the same concentration and employing the gravity method. Between 75 and 90 minutes, whenever convenient for the surgeon, the patient

is tilted to a 10° Trendelenburg position for from 75 to 90 seconds (never longer than the time required for the initial injection), and from two to three cubic centimeters (from 6 to 9 mg.) are injected again without barbotage.

Continuous-Drop Method for Subarachnoid Analgesia. Arrowood and Foldes have recently described a method for administering subarachnoid analgesia by a continuous-drop method. The lumbar puncture in the selected interspace is accomplished in the usual manner with a malleable needle. They have observed that, after the desired spinal level has been established by an initial dose of 2.5 per cent procaine in physiologic saline solution containing 3 per cent glucose, satisfactory analgesia can be maintained using a one per cent procaine solution; and that the patient's general condition continues to be better than with higher concentrations of the drug.

Management of the Patient Under Spinal Analgesia. During spinal analgesia, the patient must be attended by a competent and experienced anesthetist, not only for the successful conduction of the analgesia, but for the recognition and treatment of complications which may be serious enough to threaten the patient's life.

A slight lowering of blood pressure may be a natural concomitant of spinal analgesia. In practice, when the blood pressure is lowered beyond 25 per cent of the preanesthetic level, a serious effort is made to determine its cause. Appropriate treatment is instituted immediately. Should the pressure fall as much as 50 per cent, it is difficult to re-elevate the pressure to a normal level. Generally, the clinical condition of the patient reflects his condition more accurately than his blood pressure. The experienced anesthetist will institute vigorous supportive treatment when the patient exhibits dulling of the intellect, pallor, cyanosis, diminished pulse volume, shallow respirations and cold extremities.

A supplement of sodium pentothal or inhalation anesthesia before the operation begins tends to minimize the decrease in blood pressure which may accompany spinal analgesia.

The inhalation of oxygen is an effective measure in combating hypotension. A 10° Trendelenburg position after the analgesic drug is fixed in the tissues (20 minutes) tends to maintain a normal blood pressure. Fluids administered intravenously are valuable prophylactic and therapeutic measures in hypotension following spinal analgesia.

Obviously, blood loss and lack of gentleness during the surgical procedure may cause or aggravate a decrease in blood pressure.

Vasopressor drugs, including ephedrine, neosynephrin, pituitrin-ephedrine mixture and methedrine, are valuable agents for treating hypotension following spinal analgesia. Since absorption from the subcutaneous tissues is often retarded in the presence of a lowered blood pressure, massage of the tissues following injection or the intravenous administration of the vasopressor drug is advisable. These drugs are administered with caution in cardiovascular disease.

Depressed or arrested respirations may occur during spinal analgesia as a result of paralysis of the respiratory muscles or severe hypotension. In such instances, the anesthetist can readily administer artificial respiration by rhythmically compressing the rebreathing bag of the gas machine. It may be necessary to insert an endotracheal tube.

Nausea and Emesis. This may complicate spinal analgesia. The inhalation of oxygen through the gas machine or, in severe cases, a supplementary anesthesia with sodium pentothal or cyclopropane, will afford relief.

The sensitive or apprehensive patient may become restless during spinal analgesia, particularly where the operation is a prolonged one. Adequate preoperative medication tends to prevent this complication. An intravenous injection of morphine

and scopolamine, in doses not exceeding grains 1/6 and 1/150, respectively, may alleviate restlessness. A supplementary anesthesia with sodium pentothal or cyclopropane may be required.

Many of the serious complications of spinal analgesia occur within the first thirty minutes. The experienced anesthetist will have his armamentaria, including a gas machine and vasopressor drugs, in readiness at all times.

MEDICATIONS AND CONTRAINDICATIONS. Spinal analgesia is considered undesirable for patients with diseases of the nervous system because of the possibility that the drug may lower resistance to the disease. Furthermore, the patient may attribute a progression of the disease to the procedure. In this manner, medicolegal problems may arise. When the patient has a prejudice against spinal analgesia, it may be better avoided if the patient's confidence cannot be won. Patients exhibiting severe hemorrhage, anemia or shock tolerate inhalation anesthesia better than spinal analgesia. It is known that spinal analgesia is tolerated poorly by patients with cardiac decompensation and coronary disease. Moreover, a decrease in blood pressure or the injection of vasopressor drugs to correct such a decrease may be hazardous, in diseases of the cardiovascular system.

Spinal analgesia is not contraindicated in children, although they require greater care than do adults and a modification of the usual technic. A dose of 0.001 Gm. of procaine or 0.0001 Gm. of pontocaine per pound of normal body weight is a satisfactory basis for calculating the proper dose of the analgesic drug for children.

Since the drugs used for spinal analgesia are not metabolized or eliminated by the liver and kidneys, this form of analgesia is suitable for patients with diseases of these organs. Spinal analgesia causes less alteration in carbohydrate metabolism than inhalation anesthesia and is suitable for patients with diabetes. However, spinal analgesia affords no protection against pulmonary complications, as compared to inhalation anesthesia.

Since the excellent relaxation provided by spinal analgesia often enables the surgeon to perform the operative procedure with facility and gentleness, it is preferred by the majority of them. Spinal analgesia combined with a light general anesthesia may tax the patient's metabolism less and provide more satisfactory operating conditions for the operator than a deep general anesthesia. Spinal analgesia, either alone or in combination with other anesthetic agents and methods, seems to be indicated in any prolonged surgical procedure below the diaphragm.

Postspinal Complications. HEADACHE. Following spinal analgesia, headache is reputed to occur in from 2.5 to 30.6 per cent of the cases, although Woodward,[16] in a statistical study of 500 simple lumbar punctures, noted incapacitating headache in 19 per cent.

The occipital region is the usual site complained of, although it may be frontal or in the cervical region. Onset occurs during the first 24 hours and lasts from one to twelve days or sometimes much longer. Apparently the dosage used offers no bearing on the incidence or severity of the headache. It has been noted that patients confined to bed and receiving large amounts of intravenous fluids (dextrose) seldom develop headache.

Among the various explanations advanced are (1) hypotension, due to leakage of cerebrospinal fluid following lumbar puncture; (2) irritative meningitis (meningismus), due to subarachnoid injection of irritant solutions; (3) hypotonicity and hypertonicity of the solutions injected; (4) *p*H changes of the cerebrospinal fluid; (5) injection of air into the subarachnoid space; (6) multiple dural punctures and (7) use of large-gauge needles.

Treatment. Routinely, our patients are placed flat in bed without a pillow and the foot of the bed elevated eight inches. Thiamin chloride, 100 mg. administered orally, is given thrice daily while confined

to hospital for the three-day period (anorectal cases); subcutaneous injections are more effective. Good results have been attained by the intravenous injection of hypertonic glucose solutions. Other measures and drugs commonly employed are caffeine sodium benzoate, 7½ grains dissolved in 300 cc. physiologic saline solution, administered intravenously; surgical pituitrin, 1 cc. (ampule) in 1,500 cc. of 5 per cent glucose in saline; surgical pituitrin, 1 cc. administered intramuscularly; aminopyrine, from 5 to 10 grains administered orally every three hours; acetylsalicylic acid and phenacetin; physiologic saline, 30 cc. injected into the extradural space; 10 cc. of a 20 per cent glucose solution injected intrathecally; nicotinic acid; gynergen; ice bag to the head; darkened room and no visitors.

It may be mentioned that postspinal headache has been a real problem in our department. For a period of some eighteen years subarachnoid analgesia has been our choice and therefore has been employed almost routinely. Our incidence, reported in 1940,[7] was 11 per cent for anorectal operations. With the use of thiamin chloride, from 50 to 100 mg. thrice daily, the incidence subsequently dropped to 3 per cent, in spite of the fact that all patients are permitted out of bed in sitz baths in less than 24 hours following anorectal operation.

Meningismus. This, accompanied by severe headache, is an occasional occurrence. True meningitis is a rare complication of spinal anesthesia and is due to faulty technic.

Urinary Retention. The most frequent sequel following anorectal operations under spinal analgesia is the retention of urine, yet it is almost as high with general anesthesia. According to some,[15] the occurrence ranges between 4 and 15 per cent. Although the retention is but temporary, it is at times most distressing.

For low anorectal operations, it is routine in our department to apply compresses wrung out in hot boric acid solution for the first 24 hours and hot sitz baths thereafter. No packing is employed. Prostigmine, 15 mg., and syntropan, 200 mg., are given thrice daily until the patient voids. One bottle of beer thrice daily has been used for several years and is especially helpful. In some cases, however, catheterization has been necessary.

Backache. This is not an infrequent sequel to spinal analgesia, although Babcock observed an incidence of 16 per cent compared to 61 per cent following ether anesthesia.

Abducens Palsy. While a rarity, it may occur from 7 to 12 days postoperatively. Symptoms usually subside within a period from a few days to several weeks.

Nerve Injury. This may result from spinal analgesia. Except for the more serious injuries and degenerations, the symptoms tend to clear up spontaneously. Any portion of the central nervous system, and even the entire central nervous system may be effected. These disturbances may be permanent and even result fatally. Except for the more serious injuries and degenerations, the symptoms tend to clear up spontaneously. Simple puncture of the spinal cord by a needle does not produce symptoms.

Among the late sequelae produced by nerve injury are regions of persistent anesthesia; paresthesias, shooting pains in the legs, motor nerve paralysis and trophoneurotic changes. These are unilateral and are produced by lateral deviation of the spinal needle.

A spinal needle may come in contact with a nerve root of the cauda equina; while it produces a shooting pain down the leg, it does not result in permanent injury. A short, beveled needle will tend to push the nerve root aside, rather than puncture it.

With the purer and improved drugs that are available today, reduced concentrations and improved spinal technic in the hands of a skilled spinal anesthetist, these complications should not occur.

SUMMARY

In considering the choice of anesthesia for surgery of the anus, rectum and colon, several factors must be borne in mind: possible location of the process and its surgical approach; extent of the surgical procedure contemplated; time involved and speed of the operator; surgical and anesthetic risk of the patient; indications and contraindications for the anesthetic agent and technic of its administration.

Providing the patient is in good physical condition, we prefer to employ a low spinal analgesia in the inverted position for surgery of the anus and lower rectum. Should spinal analgesia be contraindicated, other forms of anesthesia heretofore described may be used, depending on the contraindications. In a poor risk patient, our choice has been some form of regional analgesia, particularly caudal and transsacral block.

For major surgery of the rectum and colon, our analgesia of choice is spinal, using the pontocaine-dextrose technic. A single-dose spinal is used, provided the operation requires less than an hour and a half. For any procedure requiring more than that length of time or for patients who cannot tolerate a large, single-dose spinal, our choice is the fractional method.

Routinely, our spinal injections are almost always supplemented, mainly because the patient is more comfortable. This also tends to minimize the frequency and severity of a drop in blood pressure.

Usually all that is needed to supplement spinal analgesia are small fractional doses of intravenous morphine sulfate, grains 1/8 to 1/6, and scopolamine hydrobromide, grains 1/200 to 1/150. When not contraindicated, we prefer to use fractional intravenous doses of pentothal sodium combined with nitrous oxide, from 50 to 75 per cent, by inhalation. Too, cyclopropane is an excellent supplement.

Where spinal analgesia is contraindicated, our choice is inhalation of cyclopropane and curare intravenously. The next in order of choice would be cyclopropane-ether or ethylene-ether. When employing general anesthesia without spinal anesthesia, an endotracheal tube is routinely inserted to provide an adequate airway and reduce the amplitude of the diaphragmatic excursion.

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CHAPTER 27

Preoperative and Postoperative Treatment of Patients Undergoing Anorectal Surgical Procedures

Operations about the anorectum are performed with much the same routine. In order to avoid unnecessary repetition, it has been deemed advisable to discuss in brief the preparation and care of patients undergoing minor surgical procedures in this locality. It should be borne in mind that many of the details heretofore mentioned are modified to the individual patient and to suit the preference of the individual surgeon, provided that the fundamental principles involved are properly respected.

PREOPERATIVE PROCEDURE

Ordinarily the patient is admitted to the hospital on the afternoon or night prior to operation and is given an enema consisting of a quart of warm saline solution. Nembutal (sodium pentobarbital), gr. i ss, or other suitable sedative is administered to insure a restful night's sleep. The following morning, both the perineal and lower back regions are carefully and closely shaved and prepared. In addition to the usual physical examination, blood pressure readings are recorded in both arms. Routine laboratory work, including a complete blood count, urinalysis and blood chemistry, is done. Two hours before operation, nembutal, gr. i ss, is administered by mouth. Morphine sulfate, gr. 1/6, and scopolamine, gr. 1/150, is given hypodermically one hour prior to surgery.

OPERATING-ROOM PROCEDURE

Analgesia. The patient is placed either in a sitting or left lateral position, if spinal analgesia is to be employed, or prone with hips elevated on a pillow, if the caudal or transsacral methods are to be used. (See Chap. 26, Anesthesia and Analgesia.) Immediately upon completion of the analgesia, the patient is placed in position for the operation.

Position of the Patient. All anorectal operations are performed in one of three positions.

A. Inverted, or Jackknife, Position. For many reasons this is the position of choice in the majority of anorectal operations. The patient lies prone upon the operating table, which is then broken under his hips so that head and feet are both lowered, while the buttocks are made more prominent. This position has many advantages: (1) venous engorgement is lessened and the pathology is less distorted; (2) the intestines tend to fall away from the pelvis, so that when a speculum is introduced into the anal canal, the rectum balloons out and

is readily accessible; (3) soiling of the operative field can be largely avoided; (4) the lower position of the head is ideal for lumbar analgesia with a hypobaric solution; (5) the operating position of the surgeon is distinctly more comfortable, thereby contributing to the efficiency of the operation; (6) exposure of the genital region in both male and female subjects is less apparent.

B. Exaggerated Lithotomy Position. The patient is placed upon his back, with the table in the Trendelenburg position. The feet are suspended in stirrups and the buttocks pulled well down over the edge of the table. For operations, such as long anterior fistulae, the repair of recto-urethral or rectovaginal fistulae and perineal proctosigmoidectomy, the lithotomy position is ideal.

C. Left Lateral Position (Sims'). The patient is placed on his left side with his left arm behind his back and left knee slightly bent. The right knee and hip are acutely flexed. This posture is very comfortable for the patient but necessitates holding up the right buttock when operating and may be found somewhat awkward for the surgeon.

Skin Preparation. The skin of the buttocks, perineum and sacral region is painted with a suitable antiseptic. The painting is carried out from the level of the midsacrum to a point several inches down the thighs, leaving the anus itself as the last part so that contamination is not carried from it to the surrounding skin. A strip of gauze from 8 to 10 inches long is saturated with an aqueous antiseptic, such as aqueous merthiolate or metaphen or mercurochrome, inserted into the rectum through the relaxed sphincter and removed. The operative field is then draped in the usual manner, except that two wet towels are used, one above and one below the operative area. In the jackknife position, these wet towels tend to prevent instruments from sliding off the table.

Instruments and Supplies. Visiting physicians frequently request the names and a list of instruments used, for which reason an adequate set for the average anorectal operation is appended.

2 paint cups—one for alcoholic and one for aqueous antiseptic
1 specimen pan
Gauze on sticks for painting
Medicine glass
Rubber bands
4 x 4 gauze pads opened lengthwise and wet
1 Bard-Parker knife with No. 15 blade
1 pair curved iris scissors
1 short, curved, dissecting scissors
1 straight scissors
1 toothed forceps (Babcock)
8 towel clips
1 long dressing forceps
1 Russian forceps
1 anal speculum (N. D. Smith)
1 Fansler speculum
18 curved hemostats (Rankin)
6 small, straight hemostats (Kelly)
6 small, curved hemostats (Kelly)
1 crypt hook (Martin)
1 skin hook (Rosser)
1 pair phrenic retractors for sphincter (Delaney)
1 pair retractors (Babcock)
1 Hill-Ferguson retractor
1 hemorrhoid clamp (Smith or Buie)
3 clamps (Pennington)
1 small needle holder
2 curved intestinal small heavy needles (No. 12 Ferguson or "baby Mayo")
Chromic No. 0 catgut
Plain No. 0 catgut

Dressings. Upon completion of the operation, a small strip of gauze, 4 x 4, is placed against the anal aperture and held in place by a muslin T-binder or Montgomery straps.

POSTOPERATIVE CARE AND DRESSINGS

Upon return of the patient to his room, if lumbar analgesia using a (light) hypobaric solution has been employed, the foot of the bed is elevated six inches for six hours. Blood pressure readings are made every hour for six hours. Compresses wrung out in hot boric acid solution are applied accurately to the anal margins continuously. At night these may be kept warm

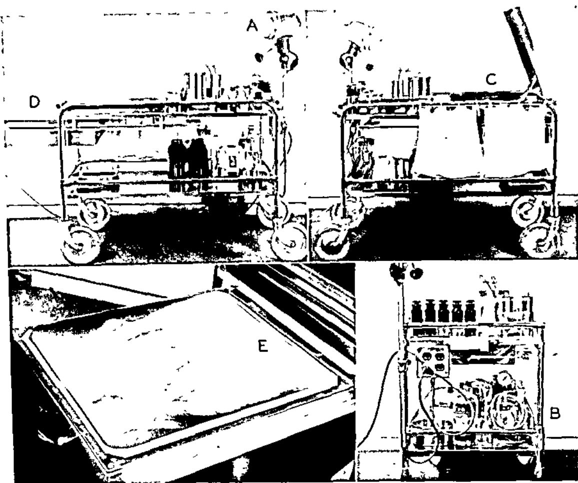


FIG. 718. Departmental carriage of stainless steel employed for examination of patients and postoperative treatment. (A) Movable light. (B) Suction motor used for sigmoidoscopy. (C) Cabinet with lock for instruments. (D) X-ray viewing box. (E) Viewing box enlarged, useful for student teaching. (Motion-picture equipment not shown.)

by a hot-water bottle (not by an electric pad). Demerol, 50 to 100 mg., is administered every 6 hours. Dilaudid, gr. $\frac{1}{32}$, is ordered every six hours only if needed. Liquids, a light soft diet and smoking are permitted immediately. Prostigmine, 15 mg., and syntropan, 200 mg., are given by mouth every four hours and continued until the patient voids. One bottle of beer is given thrice daily for the same purpose. The following day the patient is permitted hot sitz baths (6 inches deep), 110° F. for five minutes, which are continued thrice daily while the patient is confined to the hospital. To the operative wound, gentian violet, 1 per cent aqueous solution, is applied by means of a glass rod. Liquid petrolatum, ½ ounce, is administered nightly, beginning the first postoperative day and continued in decreasing amounts for a week or 10 days. On the morning of the second postoperative day, a warm olive oil enema is administered through a small, soft-rubber catheter (16 gauge) and thereafter metamucil, 1 dram in one glass of water, is given orally as needed. Ordinarily the patient is discharged from the hospital on the third postoperative day. From five to seven days following operation, the lubricated finger is gently inserted into the rectum.

Postoperative Hot Compresses. In order to prevent burning of the skin, hot

compresses are not applied until the patient has experienced a return of sensation.

Gauze compresses, 8 x 4 inches, are wrung out in hot water or boric acid solution (110° F.) and applied accurately to the anal margins.

A turkish towel or stupe flannels are wrung out of the solution also and applied over the gauze to cover part of the buttocks.

This, in turn, is covered by a hot-water bottle, and a rubber sheet is applied over the whole pack. A T-binder may be used to hold the dressing in place. By using this technic, the pack may be kept warm and moist for a prolonged period. If, however, it is desired to dispense with the bulkiness of the dressing described, gauze compresses alone may be utilized. The patient is furnished with a bowl of solution on a hot plate at the bedside so that he may change the dressings frequently (every 15 minutes).

Sitz Bath. The sitz bath is most conveniently given by means of a special plumbing fixture for that purpose. Portable sitz baths are available, but an ordinary tub or bathtub is satisfactory. The following details should be noted:

1. Optimum temperature is 100° F. If no thermometer is available, the water may be tested with the elbow, not with the hand.
2. The water should be six inches deep.
3. Ordinarily it is inadvisable to put medications in the water.
4. The bath should be given two or three times daily and following evacuations.
5. From five to ten minutes are sufficient. Longer periods in the bath may induce weakness and even syncope.

Upon discharge from the hospital, each patient is given a mimeographed sheet of instructions, as shown below:

Instructions Following Operation

Following discharge from the hospital, do not be alarmed should you experience the following: blood, slight in amount but not hemorrhage; drainage (discharge); itching; soreness or discomfort; difficulty in regulating the bowel movements. Such sensations are frequently experienced and are temporary.

Diet. Any type of food is permitted so far as the intestinal canal is concerned. Fluids freely by mouth are advocated.

Bowel Habit. For one week, mineral oil should be taken at bedtime in doses of two drachms (2 teaspoonfuls) for the purpose of lubricating the stool and to cause less irritation of the anorectum. Effort should be made to have a daily evacuation, preferably after breakfast in the morning. Should you not have a movement by the afternoon, take metamucil, 1 teaspoonful in one glass of water twice daily, or milk of magnesia, from 1 to 2 tablespoonfuls, or petrolagar, from 1 to 2 tablespoonfuls. If an evacuation does not take place within three hours, the same dose may be repeated, or castor oil, 2 teaspoonfuls, may be taken as an alternative.

Hot sitz baths should be continued upon returning home, 2, 3 or even 4 times daily, provided that an unusual degree of weakness is not experienced. The water in the tub or large foot bath should be six inches in depth, 110° F. (hot enough for elbow), and you should remain therein for a period of not more than five minutes. The sitz baths are especially ideal after evacuation. Because of weakness or menstruation, sitz baths may be omitted and hot compresses wrung out in plain hot water used.

Toilet paper should not be employed for a period of two weeks, but in its stead Kleenex or preferably absorbent cotton; the latter must be clean but not necessarily sterile. A very small piece of cotton should be placed against the anus (rectum) and worn at all times until the wound is healed.

Do not use suppositories or any ointment at any time.

Your appointment is Date ________
Day ________
Time ________

Points to Remember about Enemas.

1. Use plain water at 105° F. unless otherwise ordered.
2. Use a soft-rubber catheter (14 to 16 fr.) instead of the ordinary hard-tip enema tube.
3. Lubricate the catheter well with a water-soluble jelly.
4. Warm the tube and expel the air by running through some of the solution before using.
5. Insert the tip three or four inches only.

6. Allow the solution to run in slowly and evenly.

7. Remove the catheter before the funnel is empty, to prevent the entrance of air.

8. A funnel is to be preferred to a can. Hold it from one to three feet above the anus but no higher, unless ordered.

9. One pint ordinarily is sufficient.

10. The patient should assume the modified Sims' position (lying on the left side with both knees flexed).

PEROXIDE ENEMA. Unless otherwise specified, use a solution containing two ounces of hydrogen peroxide in one pint of water.

SODA ENEMA. Use one dram of sodium bicarbonate in one pint of water.

MILK AND MOLASSES ENEMA. This type of enema is employed for the relief of fecal impaction. The usual amount used is one-half pint of molasses to one pint of milk. They are warmed to body temperature, mixed thoroughly and administered as any ordinary type of enema.

OLIVE OIL RETENTION ENEMA. This enema is employed to allay rectal tenesmus. Usually from 4 to 8 ounces of olive oil are used. The oil is warmed to body temperature and allowed to pass slowly into the rectum through a small, soft-rubber catheter. The funnel or enema can should not be held more than from one to two feet above the level of the patient's body.

CHAPTER 28

Preoperative and Postoperative Treatment Patients Undergoing Major Surgical Procedures

INTRODUCTION

The importance of preoperative management and postoperative care of patients with cancer and other lesions of the sigmoid and rectum is well recognized, for it has become increasingly evident to those particularly interested in this subject that the recent advances in abdominal surgery which have been made in this respect have brought it to the fore. From a metabolic standpoint, the surgical management of processes in these regions is not as problematical as those of the upper gastro-intestinal tract, although complications and sequelae, with their attendant mortality and morbidity, have always caused apprehension and insecurity whenever resection was contemplated. It is true that since the advent of the newer antibacterial sulfonamides and antibiotics, the mortality and morbidity have greatly decreased, but the enthusiastic reception accorded these innovations has resulted in a tendency to overlook fundamental principles and other measures of equal, if not far greater, import.

It is our purpose in the ensuing pages to discuss briefly important factors relevant to the evaluation and preparation of patients with lesions, particularly malignant neoplasms located in the sigmoid and rectum. Pertinent phases are the production and maintenance of positive nitrogen equilibrium; correction of anemia and avitaminosis; maintenance of adequate fluid and electrolyte balance, and gastric and intestinal intubation.

In order to prepare the average patient in a proper manner for major surgery, it is essential that he be hospitalized for a period of from five to seven days. During this period, an effort is made to evaluate the patient as [illegible] check for nutri-

tional deficiencies and, in so far as is possible, place the patient in optimal fluid, caloric, nitrogen, vitamin and electrolyte balance, and prepare the bowel for surgery.

All members of our department, including the residents, are familiar with the usual routine, but each is cognizant of the fact that no set rule is applicable for all cases; therefore, each patient must be individualized. As a new intern begins service with us he receives a mimeographed copy of the following:

DEPARTMENT OF PROCTOLOGY

While each patient presents an individual equation, the following will serve as routine orders for all types of abdominal and abdominoperineal resections:

PREOPERATIVE

On admission to hospital (5 to 7 days prior to operation), all patients will have the following ordered:

(1) Bathroom privileges.

(2) Diet: High protein, high carbohydrate, low residue in four feedings. Carbohydrate, 400 Gm.; Protein, 100 Gm.; Fat, 100 Gm., supplemented by from 60 to 80 Gm. protein concentrate or hydrolysate (Delcos granules or essenamine). Combined caloric value 3,140 to 3,200 calories.

(3) Fluid intake: 2,500 to 3,500 cc. daily by mouth. Urinary output of 1,000 to 1,500 cc. to be maintained. (Specific gravity every second day.)

(4) Chart intake and output.

(5) Weight: Calculate in kilograms (2.2 lbs. per Kg.).

(6) Blood pressure, both arms, daily.

(7) Complete blood count, hematocrit. (Blood administered as indicated.)

(8) Urinalysis.

(9) Blood chemistry: Urea nitrogen, fasting glucose; serum total protein with A/G ratio; serum chlorides; specific gravity whole blood and blood plasma; CO_2 content

(10) Vitamin therapy: (S.V.A. multivitamin-tablet 1 t.i.d.) 1 tablet—ascorbic acid—100 mg., nicotinamide—50 mg., thiamine chloride—5 mg., riboflavin—5 mg., calcium panothenate—5 mg. Vitamin A, 50,000 units b.i.d.

(11) Medical consultation. Photofluorogram of chest.

(12) Urologic consultation—cystometric and cystoscopic (urine culture to be made at examination).

(13) Liver function:

Routine: (1) Prothrombin concentration.
(2) Cephalin flocculation.
(3) Bromsulfalein retention.

Optional: (1) Plasma level, vitamin A.
(2) Mean corpuscular volume of erythrocytes.
(3) Urinary and fecal excretion urobilinogen.
(4) Urinary excretion, glucuronates.
(5) Serum cholesterol and cholesterol esters.
(6) Thymol turbidity.
(7) Serum alkaline phosphatase.

(14) In obstruction, ulcerative colitis, etc.; or dehydrated patients:

(a) Blood *p*H.

(b) Blood sodium and potassium.

(c) Scout film of abdomen.

(15) Barium enema (in absence of obstruction), to determine presence of other lesions.

(16) Intestinal antiseptics: (a) sulfathalidine, 0.1 Gm. per Kg. body weight, or (b) sulfasuxidine, 0.25 Gm. per Kg. body weight in suspension form divided in 5 doses to be given at 8:00 A.M., 12 NOON, 4:00 P.M., 8:00 P.M. and 12 MIDNIGHT, together with (c) streptomycin 0.4 Gm. (orally) every 4 hours per 24 hours for two days immediately prior to operation.

(17) Vitamin K—from 30 to 60 mg. (I.M.) as indicated daily in divided doses, if the prothrombin concentration is diminished.

Beginning Third Day Prior to Operation:

(1) Cleanse and paint umbilicus daily with ether and Tr. metaphen or Tr. mercuric chloride; (2) in females: vaginal douche daily, 1:8,000 potassium permanganate; (3) ascorbic acid, 250 mg. four times daily; (4) use of hard candy and chewing gum encouraged as prophylaxis against postoperative parotitis.

Thirty-six Hours (Midnight) Prior to Operation:

(1) Castor oil, 45 cc. by mouth (except in presence of obstructive signs).

(2) No smoking permitted.

Day Before Operation:

(1) No food.

(2) Glucose or lactose, 25 Gm. in water with lemon juice, every hour x's 16 (7:00 A.M. to 10:00 P.M.) 400 Gm. or 1,600 calories.

(3) Liquids; intestinal antiseptics and amino acids continued.

(4) Prepare and shave abdomen, back and perineum.

(5) Type and cross match for 1,000 cc. blood for surgery.

(6) Hemoglobin, hematocrit, serum total protein, serum chloride and prothrombin concentration.

(7) Cleansing enema (sodium bicarbonate 10 Gm. and sulfathalidine 6 Gm.) with aspiration until clear.

(8) Blood volumetric determination.

Day of Operation:

(1) 7:00 A.M.—Irrigation of rectum until clear with aspiration employing a solution containing 6 Gm. sulfathalidine and 10 Gm. soda bicarbonate.

(2) Glucose 25 Gm. in water by mouth 7:00, 8:00 and 9:00 A.M.

(3) 1,000 cc. 5% glucose in normal saline (I.V.) with 4 cc. Betalin, 1,000 mg. ascorbic acid 9:00 A.M.

(4) Indwelling Foley catheter.
(5) Rectal tube inserted.
(6) Indwelling Levin tube connected for Wangensteen suction.
} 11:00 A.M.

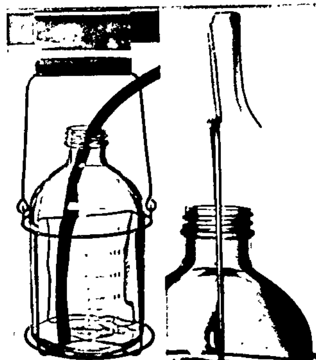


Fig. 719. Sherman urine receptacle. (*Left*) Front view. (*Right*) Side view. Clip fastens to understructure of operating table. Rack holds discarded blood bottle (500 cc.) into which the retention catheter drains via the connecting tube.

(7) In all patients over sixty and those with varicosities, the legs and thighs are wrapped snugly with elastic bandage from sole of foot to groin.
(8) Sedation ordered by anesthetic department.
} 11:00 A. M.

OPERATIVE: 1 P.M.

During Operation

(1) Blood administered as indicated by blood loss. Usually 1,000 cc. whole blood are given during operation, followed by 5% glucose in distilled water.

(2) Wangensteen open, irrigate p.r.n.

(3) Foley catheter open and connected to Sherman operating table receptacle.

(4) Where sigmoidectomy with primary anastomosis has been performed, the anus is divulsed and a No. 28 rectal tube with multiple perforations passed through the anastomosis; the rectal tube is sutured to the anal skin.

(5) Continuous oxygen.

POSTOPERATIVE

Upon Return of Patient to Room:

(1) Trendelenburg position when indicated.

(2) Continuous oxygen: 100% oxygen for a minimum of 12 hours via B.L.B. mask at rate of 7 liters per minute.

(3) Vital signs every ½ hour until stable then every 2 hours for 24 hours, then twice daily.

(4) Morphine sulfate gr. 1/6, or dilaudid, gr. 1/32, p r.n. every 6 hours (H).

(5) Wangensteen suction to Levine tube (irrigate frequently to assure patency). Suction continued until peristalsis is resumed (usually 36 hours).

(6) For sigmoidectomy and Miles excision, Babcock metal sump drain attached to Stedman pump until drainage ceases, usually 24 hours, then removed

(7) Foley catheter attached to tidal drainage.

(8) Chart intake and output.

(9) 1,000 cc. 5% glucose in distilled water (I.V.) if not given during operation. Plasma if indicated

(10) Encourage moving and turning every hour

(11) Penicillin 250,000 units every 12 hours (I.M.).

(12) Streptomycin 0.5 Gm. every 6 hours (I.M.) where fecal spillage occurred.

First and Subsequent Days:

(1) Analgesics: Demerol from 50 to 100 mg. preferred. Dilaudid or morphine sulfate if indicated

(2) Semi-Fowler position with legs straight. (No pillows beneath or elevation of knees allowed) Exercise legs every 15 minutes. Encourage moving, turning and deep breathing every hour.

(3) Intake and output charted daily.

(4) Fluid intake from 2,000 to 3,500 cc. daily by parenteral route until these volumes can be taken orally. Requirement determined by skin turgor, perspiration, comparative preoperative and postoperative blood studies, urinary output, loss by vaporization Wangensteen suction, Babcock sump.

Example: (a) Oral intake limited to maximum of 1,000 cc. H_2O, or Ringer's solution with gastric suction open.

(b) Glucose 5% in normal saline (0.9%) administered to equal volume aspirated via Wangensteen suction and sump drain, plus estimated salt loss by perspiration.

(c) Glucose 5% in distilled water administered to equal volume urine output (from 800 to 1,000 cc. minimum desired and anticipated on first postoperative day), plus estimated water loss by vaporization (1,000 cc. minimum).

(d) Daily protein requirement fulfilled by supplementing fluids with (1 Gm. per Kg. body weight) protein hydrolysate as parenamine or amigen.

(e) Whole blood and/or plasma in small transfusions (250 cc.) if indicated according to R B C., hematocrit and total serum protein.

(f) M/6 sodium lactate 100 cc. ampule (Lilly) added to 500 cc. sterile distilled water is equivalent to 8.4 Gm. $NaHCO_3$. (Amount of $NaHCO_3$ needed is determined by: Kg. Wt. x CO_2 content deficit x 0.026 in grams).

(5) Blood studies. R.B.C., hemoglobin, hematocrit and A/G ratio every second day as indicated. Total serum protein, chlorides and CO_2 content daily during immediate postoperative period. Specific gravity plasma, specific gravity whole blood (blood *p*H only if indicated).

(6) Perineal drain (metal presacral) or sump drain removed at end of 24 hours. Perineal dressings changed.

(7) Bladder irrigated twice daily through catheter with warm boric acid solution.

(8) Gentle irrigation of colon catheter with warm sterile saline solution, from 100 to 200 cc. twice daily

for A.P.P.S. (proctosigmoidectomy and sigmoidectomy); every four hours for abdominal colostomy (Miles).

(9) Following removal of gastric suction tube and after first bowel movement:

(a) Sulfathalidine (M.) or sulfasuxidine (M.), preoperative dose in suspension form every 4 hours.

(b) Vitamin therapy—

(1) Vit. A—100,000 units daily.

(2) Ascorbic acid—250 mg. t.i.d.

(3) Betalin—4 cc. daily I.M. or I.V.

(c) Iron therapy if indicated.

(10) Remove Daniel clamp and colon catheter (A.P.P.S.) on 4th postoperative day.

(11) Ambulation 3rd postoperative day (Miles resection); 4th postoperative day (A.P.P.S.).

(12) Hot sitz baths, 110° F., 5 minutes, 6 inches deep, t.i.d. beginning 4th postoperative day.

(13) Gradually return patient to preoperative low-residue diet—carbohydrate 400 Gm., protein 100 Gm., fat 100 Gm. in four feedings.

(14) Cystometric reading 5th postoperative day by urologic consultant—urinalysis and culture.

(15) All abdominal skin sutures removed between 5th and 7th postoperative day.

(16) Rehabilitative physical therapy (ultraviolet and massage).

PREOPERATIVE MANAGEMENT

Nutrition of the Surgical Patient

Nutrition has assumed a position of paramount importance during the past few years. It was inevitable that this should occur following the discovery that glucose, saline and other forms of therapy could be used to such signal advantage when administered parenterally in the postoperative stage to maintain carbohydrate nutrition and fluid balance. That this would stimulate research in other phases of nutrition applicable to the surgical patient was also a foregone conclusion. Emerging from these researches were the production of parenteral amino acids and the use of vitamins. The importance of nutrition in terms of postoperative care and treatment is amply demonstrated in drawing attention to an obvious fact—the presence of nutritional impairment in patients with malignant growths. Numerous investigations by various groups have demonstrated that malnutrition is invariably present in patients with cancer of the gastro-intestinal tract. Among the reasons advanced for this postulation are (1) lack of proper dietary and vitamin intake; (2) poor absorption; (3) rapid loss of fluid and food as a result of vomiting or diarrhea; (4) hepatic dysfunction; (5) toxicity, with attendant metabolic upsets, etc.

Minot[140] has asserted that defective nutrition can arise when the diet seems adequate because of some disturbance in the state of the gastro-intestinal tract and its contents, which may act adversely to "condition" or enhance a deficiency of nutritional factors within the body proper.

Protein deficiency, *per se*, may lead in time to actual edema of the intestinal mucosa and result in poor intestinal absorption, thus completing the vicious cycle. James has concurred in this observation.[98] A number of investigators, among them Kelly, Sheppard[107] and Youmans,[209] have demonstrated that many individuals in the upper income brackets have failed to avail themselves of proper types of diet, particularly that consisting of adequate vitamin and mineral content. It would seem apparent from this assumption that those in the lower income groups in all probability have an appreciably greater deficiency.

Youmans and his co-workers found this true, observing that protein deficiency did exist in the diets of a rural population. That this deficiency state should assume greater prominence in relation to malnutrition when present in patients with lower bowel cancer can be readily appreciated.

Significance of Protein Nutrition. Its Preoperative Role in Patients with Cancer of the Lower Colon and Rectum. It is an established fact that depletion of body proteins and impairment of protein metabolism can result from disease processes. Therefore, it is our chief concern in this discussion to correlate the effects which cancer of the lower colon and rectum produce in connection with these factors, in order that any existing abnormality may be corrected preoperatively.

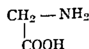
James and Eaton[102] were among the first

to observe that hypoproteinemia was of common occurence in patients with gastro-intestinal cancer, while Hartzell[69] found it present quite frequently in general surgical patients. Their findings have been confirmed many times during the intervening years. The author, with his co-worker,[21] determined that 22 out of our 74 consecutive cases (29.7 per cent) with cancer of the sigmoid and rectum presented a hypoproteinemia with levels of less than 6.5 Gm. per cent. Similar results were obtained by Meyer and Kozoll,[113] who reported that 29.3 per cent of their cases with gastro-intestinal cancer were hypoproteinemic. Binkley and associates,[31] in 1943, disclosed that 23 patients of a group of 65, or 36 per cent, had plasma protein levels of less than 6.5 per cent per 100 cc. Of these 65, 60 had apparently maintained adequate protein intake.

Abels *et al.*[2] demonstrated hypoproteinemia in terms of wound-healing. The reduction in blood volume accompanying it, with the attendant predisposition to shock, postoperative edema in wounds and surrounding suture lines, increased susceptibility to infection and hepatic dysfunction, are to be discussed in greater detail under Postoperative Care. Casual mention has been made here with the sole purpose of attracting attention to the necessity and importance of determining the exact status of the body proteins from the standpoint of preoperative therapy with a view of correcting obvious depletions and of building up a large protein reserve. It must be remembered that it is equally important and necessary to maintain a positive nitrogen balance. It is not the author's intention to discuss in detail protein metabolism, but it is believed that a brief review of the physiology of the proteins would not be amiss, in order that a clearer understanding of their clinical significance in relation to deficiency states, both preoperatively and postoperatively, might be apparent.

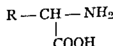
Proteins are the most important components of food and are essential for growth and repair of injury to the body. Youmans[209] believes that proteins are required in the formation of all living cells, in the building up of these cells incident to growth and in their replacement in the adult. They are exceedingly complex organic compounds, composed for the greater part of hydrogen, carbon, oxygen and nitrogen, being distinguished nutritionally by their content of the latter element. These proteins are built up within the body from the essential amino acids.

FORMATION OF PROTEINS. Ingested proteins are broken down in the stomach by the action of pepsin and hydrochloric acid to proteoses and peptones. In the small intestine, the latter are reduced by the action of trypsin to polypeptides, and these, in turn, are reduced to amino acids by the action of pepsinases. The amino acids are *absorbed through the intestinal* villi into the blood stream and carried to the liver, there being converted into plasma proteins, and thence to the tissues, where they form tissue proteins. According to Best and Taylor,[31] the protein molecule is composed of a number of variable units called amino acids, of which 23 or more have been identified. Proteins may contain, at times, from 3 to 15 of these amino acids. Due to differences in molecular structure and pattern, proteins vary considerably, showing differences in physical properties, such as elasticity, osmotic pressure or viscosity. Amino acids may be regarded as derivatives of the fatty acid series, in which the alpha hydrogen atom has been replaced by an NH_2 group. The simplest amino acid is amino acetic (glycine or glycocoll). The chemical formula may be expressed as:



$$\begin{array}{l} CH_2 - NH_2 \\ | \\ COOH \end{array}$$

The structure of the other amino acids, with the exception of proline and oxyproline, may be expressed in the following chemical formula:



$$\begin{array}{l} R - CH - NH_2 \\ \quad\;\; | \\ \quad\;\; COOH \end{array}$$

The amino acids contain a basic NH_2 group and an acid COOH group. A protein molecule is synthesized by the formation of chains of amino acids by linkage of the basic group of another, with liberation of a molecule of water. The junction of $CO - NH_2$ whereby

the amino acids are linked, is called the peptide linkage. Separation or hydrolysis can also take place at this link, a molecule of water being taken up first. When these amino acids are linked together as described, the resultant protein contains free NH_2 and COOH groups and thus can act either as a weak acid or weak base. In acid solution, it acts as a base yielding cations to form protein, chloride, sulfate, etc. In alkaline solution, it acts as an acid yielding anions to form proteinases of sodium, potassium, etc. Substances of this type are termed amphoteric.

The human organism is capable of synthesizing certain amino acids, but as to the method of procedure in their formation, physiologists are yet uncertain. Some of the complex amino acids are incapable of being formed in the body and must be supplied by the diet; these are termed the essential amino acids. According to Best and Taylor (*op. cit.*), amino acids which are not used in their original form for building body protein or for manufacturing hormones and other secretions are deaminized, i.e., broken down into the incombustible amino group (NH_2) and the fatty acid residue. The ammonia is combined with CO_2 to form urea, and the fatty acid is either oxidized to furnish energy or transformed into glucose (which in time may be burned, stored as glycogen or turned into fat). Only some amino acids form glycogen. Approximately 58 Gm. of glucose may be formed from 100 Gm. of protein. Deamination is carried out principally in the liver, but also occurs in the kidneys and intestinal mucosa and perhaps in other tissues. The end-products of protein catabolism are urea, amino acids, uric acid, creatine and ammonia, purines and other nonprotein substances of unknown nature (undetermined N). Most of these are excreted in the urine.

Function of the Plasma Proteins. This type of protein possesses great surgical significance. Its chief functions are (1) maintenance of osmotic pressure; (2) production of viscosity in the blood and maintenance of normal blood pressure; (3) acid formation to regulate the acid-base balance; (4) globulin and fibrinogen fractions, which influence rouleau formation of the corpuscles and clumping; (5) used by the leukocytes to prepare substances (trephones) necessary for nourishment of tissue cells grown in culture; (6) quinine substances are attached to the globulin fraction; (7) to act the role of protein reserves; (8) formation of fibrinogen, essential to clotting.

The plasma proteins, albumin, globulin and fibrinogen are obviously of great clinical significance since they possess important physiologic attributes. There are five possible sources of these fractions: disintegration of the red or white blood cells; the general tissue cells; the reticulo-endothelial system; and the liver (fibrinogen is almost certainly produced in that organ; the concentration of fibrinogen appreciably decreases following liver trauma or hepatectomy). It seems certain that the plasma proteins are derived from the tissues and are regenerated rather slowly (from 7 to 14 days) following acute losses, which has been demonstrated by Kerr and others.[108 197] The definite relationship between tissue and plasma proteins with the former acting as a source of the latter has been demonstrated by the work of Kerr (*op. cit.*), Weech,[197] Elman,[175] and Whipple.[128] This is but a part of the increasing array of evidence indicating that serum albumin definitely reflects change in body nutrition as a whole. Other than this, the most important function possessed by the serum albumins is the maintenance of plasma volume. Its importance in terms of edema are well known. Physiologic functions are, however, more or less varied and, although possessing immeasurable importance, they must, of necessity, receive but passing mention in this discussion. It has been determined, as a result of intensified study, that antibodies are globulins. Fibrinogen may also be classified likewise; it is the sole precursor of fibrin, which goes to make up the matrix of blood clots. Its source is, in all probability, the liver. Contrary to albumin, it can be manufactured with such rapidity that only overwhelming hepatic trauma will lead to a deficiency of plasma fibrinogen. Prothrombin, together with the thromboplastic substance found to be deficient in the hemophiliac patient, is also a globulin.

Salter[176] has recently voiced the opinion that many of the important physiologically active substances are of a catalytic nature, such as the enzymes and hormones. They belong to the globulin group (amylase, alkaline and acid phosphatase, for example).

Although not possessing the significance of the albumin fraction relevant to nutrition, the globulin fraction, as such, obviously plays an important role in the terms of disease. Discussion of this physiologic action of the proteins is incomplete without mention being made of that more or less vague entity, viz., "the protein reserve."

The Protein Reserve. Best and Taylor[31]

asserted that protein storage does not occur aside from the increase during growth, the puerperium, etc. McLester[140] believes that protein deposits are of two types: one in which the protein is utilized immediately, the other where it is less readily available. Youmans[208] stressed the immensely wide range in protein necessary to provide the variety of amino acids, pointing out that the body therefore possesses a greater protein reserve, or a depot, in addition to the daily intake, on which it may draw protein for all purposes and which serves to tide it over periods of deficient intake or abnormal demand. Recent studies with isotopes indicate that there is a general pool of nitrogen formed from dietary and reactivated body tissue-nitrogen from which protein may be formed for any purpose. With increased and greater severity in deficiencies, the body tissues are drawn on for protein to supply the most demanding purposes, the less important structures being drawn on first. In a severe type of deficiency, even such important organs as the heart are called on to yield a portion of their protein. That stored in the active parenchymal cells of such organs as the liver seems to be the least affected.

PROTEIN REQUIREMENTS AND INTAKE. As previously stated, it is known that the body can synthesize certain amino acids. Others, such as the more complex tryptophan and histidine, must be supplied in the diet. In connection with the latter amino acid, a report from the Rose Laboratory, in 1943, stated that investigators had advanced a theory that histidine is not at all necessary for the maintenance of nitrogen equilibrium in man. These results were indeed surprising and obviously quite unexpected, as heretofore histidine had been classified as one of the ten necessary amino acids to adequately supply and keep constant the nitrogen balance. Accordingly, they did not accept their findings as final, as it was thought that the amount which, in all probability, was requisite and necessary might be infinitesimal and that further experiment might clarify this apparent discrepancy. As a result of further experimentation, they observed that, under short term conditions, histidine deficiency was not associated with any disturbance of the nitrogen equilibrium. It has also been thought advisable to mention that, through the mechanism of decarboxylation, or the subtraction of one molecule of CO_2 from the chemical formula of histidine, the formation of histamine occurs. Histamine is one of the main causes of anaphylactic shock, and Dragstedt[50] has proved experimentally that histamine is liberated from human tissues and blood cells upon exposure to specific allergens and that during phases of exacerbation of allergic symptoms, blood histamine is frequently elevated and that its discharge into the plasma or tissues appears to be the dominant factor responsible for all the symptoms of anaphylaxis. This is a rather pertinent finding in the presence of shock, as the author stated that various areas subjected to experimental trauma showed an increase in histamine content; and trauma occurring in the course of a surgical procedure can be a factor causative of shock.

Best and Taylor list the following as essential amino acids: threonine; valine; leucine; isoleucine; norleucine; arginine; lysine; methionine; phenylalanine; tryptophan; histidine and tyrosine. These are important in a consideration of the various amino acids available for oral or parenteral administration. According to the authors, the most suitable proteins for growth are lactalbumin (of milk); ovalbumin and ovitelline (of egg); meat proteins; glutenin (wheat); casein (milk); glutelin (maize); and glycine (soy bean), in the descending order of protein value. Meat and milk protein head the list, the former being preferable to the latter due to greater digestibility. Milk protein (casein) contains all the amino acids essential to maintain life, although poor in cystine. It suffices, however, to maintain growth and vigor, even when used alone.

According to McLester,[140] determination of the optimum protein intake is rather difficult to state, the question arising whether the minimal amount to maintain nitrogen balance plus the factor of safety should be administered or whether a high protein diet is more effective. Arguments against the latter have arisen, with but little basis of proof to support the contention. It has been shown that workers may exist for indefinite periods ingesting from 40 to 50 Gm. of protein daily. Other groups of investigators believed that a depressed sexual urge, mental sluggishness and increased susceptibility to disease, such as tuberculosis, occur under insufficient protein intake. It has been concluded that a diet supplying an amount of protein in excess of that required to support and maintain growth is more satisfactory from the point of view of maintaining vigor for extended periods than is a diet containing exact amounts necessary for growth maintenance.

Protein not only furnishes fuel and material for replacement but also, through its specific

dynamic action, stimulates vigor and general physiologic efficiency. The latter effect is obtained from surplus protein that is not used for growth, storage and repair. McLester gave his opinion that 100 Gm. or more administered daily in the form of meat, eggs and milk should be ingested. It has been generally agreed by nutritionists that a liberal protein intake is not harmful to either the kidneys or the vascular system, the accepted protein intake for an average individual is from 1.0 to 1.5 Gm. per Kg. of body weight. Numerous writers have recommended a much higher amount, as much as from 2 to 3 Gm. per Kg. in acute losses or toxic conditions and the wasting diseases. (*We have established this as a minimum for our patients as preoperative routine procedures.*)

The Nitrogen Balance. Nitrogen balance is a term which has been in use much more commonly in recent years because protein metabolism and its relation to disease have assumed a place of increasing importance.

Best and Taylor, explaining this trend, state in part: "The difference between nitrogen ingested in the food and that excreted in both the feces and urine is termed the nitrogen balance." When intake and output are equal, the body is said to be in nitrogen balance. Where intake exceeds output, a positive balance is present, or, in other words, the nitrogen is being retained in the body. Where the reverse is present, negative balance has occurred. Patients within this negative sphere would obviously require not only the normal protein requirements but also an extra allowance to replace the protein reserve and restore tissues to their normal state.

Evaluation and Correction of Protein Deficiency. There are two essential procedures necessary in the correction of this deficiency when present: (1) estimation of the total serum proteins and (2) the albumin/globulin ratio. Additionally, the total plasma volume should be determined. Elevated levels of serum protein should not lead to the erroneous assumption that they are adequate, as in many instances patients have colonic or rectal malignancies, possess all the earmarks of malnourishment, yet have normal protein values. In this, clinical judgment should be relied on, regardless of the blood studies or the clinical picture present in the patient. It has been the author's policy that, following hospitalization of the patient, a diet high in protein content, furnishing a minimum of two Gm. of protein per kilo of body weight, is administered in the form of a nonresidue diet containing 100 Gm. of protein. It is impractical to offer a greater volume of protein on the patient's tray since he is unable to consume more bulk. But the protein intake can be supplemented by giving from 60 to 80 Gm. of protein concentrate or hydrolysate in divided feedings between meals. The total caloric values and other features will be discussed under preoperative dietary regime.

By following this form of treatment in a large group of cases, we have found that blood protein levels have become increased in seven days' time with the result that our patients undergo surgery extremely well. Where obstruction is evident, it is our opinion that it is important to set up a positive nitrogen balance and to administer parenterial amino acids together with whole blood and plasma in an effort to accomplish the desired result.

Fat Metabolism. Fats are used within the body to supply energy. Of all food material, it is the sole article stored in the dry state and sets up more energy per gram than either carbohydrate or protein. There is more or less controversy over the functions of the various fatty elements, but recent investigations have brought out facts concerning the complexity of these various functions.

There is increasing evidence concerning the interrelationship between fats, carbohydrates and proteins and their metabolic role within the body. It has become apparent that fats protect the protein reserve by an adequate intake of both in the diet, thereby relieving the tissue proteins of the necessity of furnishing required energy. The

liver plays an extremely important part in fat metabolism. Fats are stored, ketone bodies are formed, and neutral fats are accumulated in this organ. Various conditions, such as starvation, diets high in fat content or cholesterol, or low choline, methionine, etc., result in an excess of fat storage within the liver. Such types fail to function well, and the importance of the resultant dysfunction will be discussed under Liver Disorders.

Significance of Fat Metabolism. As in the case of various other foods, it is important to realize that adequate nutrition of the surgical patient depends largely on a well-balanced diet. Fat is a very important supplement in preserving and furnishing energy. However, excess storage in either the obese or semistarved patient results in lowered glycogen content and hepatic dysfunction.

It is more or less difficult to rearrange the deposition of fat within an allotted period of time consisting of from five to seven days, but, by assuring a high carbohydrate intake, it becomes possible to increase the liver glycogen. There is the added factor of low-residue diet to contend with, but, by the administration of cream, an adequate fat intake is assured.

The literature devoted to nutrition has, in recent years, given considerable space to protein metabolism, thereby sacrificing the equally important inclusion of both fat and carbohydrate constituents in the diet.

Carbohydrate Metabolism. Contrary to general belief, the large intestine is very importantly concerned in carbohydrate metabolism. Due to the presence of malignant neoplastic growths, a general depletion of body tissues has resulted in complete disorganization of the absorptive powers of these tissues, not alone in the large bowel but also elsewhere. Although protein metabolism is of somewhat greater significance from the standpoint of surgery, adequate carbohydrate intake is equally necessary for the utilization of these proteins. Metabolic processes involved in relation to the three main foods are so closely allied that a clear understanding of the functions relevant to all of them is necessary if adequate preoperative preparation of the patient is to be assured.

Functions and Use of Carbohydrates. The body tissues constantly require and make use of carbohydrates under all physiologic conditions. Even a temporary drop in blood sugar levels below those deemed critical will result in serious disability. Nevertheless, the amount of carbohydrates within the body at any one time is exceedingly small and this amount, if not promptly replaced when used, would sustain life for but a fraction of a single day. Therefore, unless sufficiently large amounts of carbohydrate are ingested regularly in the food, body needs, obviously, must be met by conversion of other foodstuffs into carbohydrate.

The body carbohydrates are largely present as glycogen found in the skeletal, cardiac and smooth muscles. Here it serves as an emergency reserve of fuel; it is also encountered in the manufacture and distribution system, i.e., in the liver as glycogen and in the blood stream and extracellular fluids in the form of glucose. The chief function of the latter is to supply the fuel used in muscular exercise. It may be indirectly synthesized from either protein or fat when unavailable from usual sources. However, it may readily be seen that ingestion of adequate protein spares the body the necessity of manufacturing its fuel. This phase is quite important in furnishing food for surgical patients since carbohydrate is definitely more efficient fuel than either protein or fat. Liver carbohydrate is not alone a fuel reserve; it also exerts both a protective and detoxifying action and, in addition, a regulating influence on protein and fat metabolism. From animal experimentation, it is well known that the livers in the well-fed types contain a high percentage of glycogen and that well-fed persons are

capable of resisting the ingestion of noxious agents to a greater degree than those who are half-starved or malnourished.

Soskin expressed the opinion that liver glycogen is present in a form which is quite complex. The presence of carbohydrates within the liver also effects glucuronate formation and acetylation. That carbohydrates possess a protein-sparing action in the role of deamination has also been confirmed. According to this author, a minimal intake of protein may be all that is required if adequate amounts of carbohydrate have been ingested. The effectiveness of carbohydrate administration in ketosis led to its being classified as an antiketogenic action. This takes place in the liver and is due to inhibiting the breakdown of fatty acids.

The necessity of adequate glycogen storage in the cardiac muscle is well known, and the additional importance of carbohydrates in the central nervous system has been repeatedly stressed. The part taken by carbohydrates in fat storage also deserves mention. Fat arises from carbohydrates, but the latter cannot efficiently act as a substitute for fat as they do not carry the essential fatty acids and fat-soluble vitamins.

Significance of Carbohydrate Metabolism. When the functions of carbohydrates have been reviewed, particularly with reference to their association with liver function and their interrelationship with both protein and fat metabolism, and their additional significance in terms of nutrition of the surgical patient, it becomes quite obviously necessary that depletion of glycogen reserves, which is invariably present in the malnourished individual having lower bowel cancer, be promptly replaced preparatory to surgical procedures and maintained at optimum levels postoperatively.

Diet. Diet, *per se*, is important from the standpoint of the residue it yields. Undoubtedly, adequate preparation of the bowel has been a tremendous factor in lowering mortality following operative procedures on the large intestine. It was our experience[21] that a low-residue diet consisting of 400 Gm. of carbohydrate, 100 Gm. of protein and 100 Gm. of fat, supplemented by from 60 to 80 Gm. of protein concentrate or hydrolysate, resulted in an appreciable degree of success. This diet provided from 3,140 to 3,220 calories with from 1.5 to 2.0 Gm. of protein per kilo of body weight.

Preparation of Bowel. A clean, tranquil bowel is of the utmost value at the time of operation. In addition to the diet, castor oil, 45 cc., is given 36 hours prior to operation. On the morning of operation, irrigation of the rectum is effected with a solution containing 10 Gm. of sodium bicarbonate and 6 Gm. of sulfathalidine. This is administered with aspiration until the return is clear. By the use of this procedure, the bowel is usually clean.

In cases of partial obstruction, a rather thick, gummy residue was present in the colon when sulfathalidine had been used. However, this sulfonamide reduced the coliform counts more effectively than did sulfasuxidine, for which reason its use is preferred.

In the matter of catharsis, other workers in this field are of the opinion that a more drastic use of this measure is indicated to thoroughly cleanse the bowel. It is our opinion, however, that this may result in the loss of both valuable proteins and vitamins. Poth[175] asserted that immediately following the use of laxatives, the coliform count increases, due to a decrease in concentration of sulfathalidine. It has been our experience that serum proteins (and total circulating plasma proteins) have been increased by use of the above regime, with a corresponding rapid drop in the coliform counts to less than 1,250 organisms per Gm. of wet stool.

Correction of Anemia

For years the importance of anemia in the presence of malignancies of the gastrointestinal tract has been considered, but only relatively recently has the real sig-

liver plays an extremely important part in fat metabolism. Fats are stored, ketone bodies are formed, and neutral fats are accumulated in this organ. Various conditions, such as starvation, diets high in fat content or cholesterol, or low choline, methionine, etc., result in an excess of fat storage within the liver. Such types fail to function well, and the importance of the resultant dysfunction will be discussed under Liver Disorders.

SIGNIFICANCE OF FAT METABOLISM. As in the case of various other foods, it is important to realize that adequate nutrition of the surgical patient depends largely on a well-balanced diet. Fat is a very important supplement in preserving and furnishing energy. However, excess storage in either the obese or semistarved patient results in lowered glycogen content and hepatic dysfunction.

It is more or less difficult to rearrange the deposition of fat within an allotted period of time consisting of from five to seven days, but, by assuring a high carbohydrate intake, it becomes possible to increase the liver glycogen. There is the added factor of low-residue diet to contend with, but, by the administration of cream, an adequate fat intake is assured.

The literature devoted to nutrition has, in recent years, given considerable space to protein metabolism, thereby sacrificing the equally important inclusion of both fat and carbohydrate constituents in the diet.

CARBOHYDRATE METABOLISM. Contrary to general belief, the large intestine is very importantly concerned in carbohydrate metabolism. Due to the presence of malignant neoplastic growths, a general depletion of body tissues has resulted in complete disorganization of the absorptive powers of these tissues, not alone in the large bowel but also elsewhere. Although protein metabolism is of somewhat greater significance from the standpoint of surgery, adequate carbohydrate intake is equally necessary for the utilization of these proteins. Metabolic processes involved in relation to the three main foods are so closely allied that a clear understanding of the functions relevant to all of them is necessary if adequate preoperative preparation of the patient is *to be assured.*

Functions and Use of Carbohydrates. The body tissues constantly require and make use of carbohydrates under all physiologic conditions. Even a temporary drop in blood sugar levels below those deemed critical will result in serious disability. Nevertheless, the amount of carbohydrates within the body at any one time is exceedingly small and this amount, if not promptly replaced when used, would sustain life for but a fraction of a single day. Therefore, unless sufficiently large amounts of carbohydrate are ingested regularly in the food, body needs, obviously, must be met by conversion of other foodstuffs into carbohydrate.

The body carbohydrates are largely present as glycogen found in the skeletal, cardiac and smooth muscles. Here it serves as an emergency reserve of fuel; it is also encountered in the manufacture and distribution system, i.e., in the liver as glycogen and in the blood stream and extracellular fluids in the form of glucose. The chief function of the latter is to supply the fuel used in muscular exercise. It may be indirectly synthesized from either protein or fat when unavailable from usual sources. However, it may readily be seen that ingestion of adequate protein spares the body the necessity of manufacturing its fuel. This phase is quite important in furnishing food for surgical patients since carbohydrate is definitely more efficient fuel than either protein or fat. Liver carbohydrate is not alone a fuel reserve; it also exerts both a protective and detoxifying action and, in addition, a regulating influence on protein and fat metabolism. From animal experimentation, it is well known that the livers in the well-fed types contain a high percentage of glycogen and that well-fed persons are

capable of resisting the ingestion of noxious agents to a greater degree than those who are half-starved or malnourished.

Soskin expressed the opinion that liver glycogen is present in a form which is quite complex. The presence of carbohydrates within the liver also effects glucuronate formation and acetylation. That carbohydrates possess a protein-sparing action in the role of deamination has also been confirmed. According to this author, a minimal intake of protein may be all that is required if adequate amounts of carbohydrate have been ingested. The effectiveness of carbohydrate administration in ketosis led to its being classified as an antiketogenic action. This takes place in the liver and is due to inhibiting the breakdown of fatty acids.

The necessity of adequate glycogen storage in the cardiac muscle is well known, and the additional importance of carbohydrates in the central nervous system has been repeatedly stressed. The part taken by carbohydrates in fat storage also deserves mention. Fat arises from carbohydrates, but the latter cannot efficiently act as a substitute for fat as they do not carry the essential fatty acids and fat-soluble vitamins.

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Correction of Anemia

For years the importance of anemia in the presence of malignancies of the gastrointestinal tract has been considered, but only relatively recently has the real sig-

nificance of this factor been widely recognized. Experience with the use of plasma and blood resulting in the miraculous survival of what were formerly considered to be hopeless cases in the recent conflict added impetus to civilian studies of preoperative anemia and blood loss during operation. As a result, we now have a rather concrete foundation upon which to base the correction of anemia and replacement of blood loss.

Preoperatively after an estimation of the anemia, 500 cc. blood transfusions are administered until normal erythrocyte, hemoglobin and hematocrit figures are approached (4,500,000 erythrocyte count, from 80 to 90 per cent hemoglobin and 40 to 45 per cent hematocrit). If transfusions are administered soon after admission, care must be exercised that the anemia does not recur during the preoperative period. This has happened occasionally in our cases, and, for this reason, the status of the blood is determined routinely on the day prior to operation, so that recurrence may be remedied. The importance of establishing a positive nitrogen balance has already been stressed, and the use of whole blood greatly simplifies this procedure. Gatch and Little,[79] White and Buxton,[202] Coller,[53] Pack[101] and others have estimated the loss of blood which occurs during abdominoperineal resections and found a rather large variance (from 250 to 900 cc.). Most of the cases averaged from 400 to 500 cc. of blood loss. Formerly, we administered 500 cc. of blood during resection of the rectum, but now it has become routine to use as much as 1,000 cc. during resection. Not infrequently, 500 cc. of blood are given when the patient returns to the room. As a general rule, this has prevented any appreciable postoperative anemia. In fact, only occasionally following operation is additional blood needed.

Transfusion Reactions. This occurrence is of relative infrequency in our experience even though many transfusions are given. It is our conviction that this is due to a number of precautionary measures which are adhered to by the blood bank. We have no intention of discussing this phase of the problem, but since we have advocated the use of large amounts of whole blood, it seems expedient to outline our plan of prophylaxis and treatment of severe complications following transfusion reactions.

The responsibility of prevention falls on the blood bank and hospital supply where tubing, etc., are prepared. It is the surgeon's responsibility, however, to see that the Rh factor is closely watched. Great care should be taken by the bank in selection of donors; the Rh factor is determined in all patients to insure that this grave incompatibility will not occur.

Hemolytic Reactions. The chief problem of the surgeon is to detect the early signs and symptoms of hemolytic reactions in order to forestall severe complications. It is important that all personnel are familiar with these early symptoms, which may be listed as follows: generalized tingling sensation, discomfort, anxiety, fullness in the head, precordial pain or distress and sudden sharp pain in the *lumbar region* (pathognomonic); and later, dyspnea, severe chills followed by febrile reactions, hemorrhagic tendency and hemoglobinemia may occur. Prior to the occurrence of severe renal complications an interval phase exists in which the patient may be apparently improved, with oliguria and jaundice. In a week or ten days, the severe renal complications may ensue with uremia, etc., *being* present.

Routinely, an attempt is made to maintain blood alkalinity by keeping the carbon dioxide content above 55. The urinary *p*H is estimated daily and in the presence of an acid reaction, blood transfusions are preceded by from 250 to 500 cc. of 1/6 molar sodium lactate or soda bicarbonate in doses of from 50 to 150 grains, depending on the acidity of the urine or the degree of acidity as determined by the CO_2 content deficit. (Kg. wt. x CO_2 content deficit x 0.026 in grams.) Another important precautionary measure where amino acids are being used,

is to administer the blood prior to the amino acids. If it is necessary to follow the latter with blood, then sodium lactate or soda bicarbonate should be used. The accompanying chart is an outline of the procedures employed following hemolytic reactions or symptoms indicative of such reactions.

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DEPARTMENT OF PROCTOLOGY

Procedure to be Employed following Hemolytic Transfusion Reaction:

1 Stop transfusion immediately: substitute blood plasma if required.

2. Administer alkali immediately: two teaspoonfuls sodium bicarbonate (3 II or Gm. VIII or gr. Cxx) by mouth in water.

3. Using a dry syringe (autoclaved or paraffined), draw blood, centrifuge and examine plasma for hemolysis to prove that a hemolytic reaction has occurred; determine bilirubin content; repeat in 6 and 12 hours.

4. Determine total serum (CO_2 content* and alkalinize to restore CO_2 Deficit x 0.026).

Administer sodium bicarbonate intravenously in form of:

M/6 sodium lactate solution (100 cc. ampule, Lilly, molar solution equivalent to 8.4 Gm. $NaHCO_3$).

OR

Sodium bicarbonate (100 cc. ampule, Abbott, contains 7.5 Gm. $NaHCO_3$).

5. Test patient's blood and donor's blood for Rh factor.

6 Catheterize patient one (1) hour following appearance of hemolytic reaction. Examine urine for hemoglobin, red blood cells, hematinic casts, bilirubin and *p*H. Repeat in 6 and 12 hours.

7. Hematocrit, nonprotein nitrogen, serum chlorides, serum proteins, total serum carbon dioxide* content and (when possible, serum *p*H)* daily.

8. Transfusion of Rh negative blood and/or blood plasma to restore cell volume and plasma proteins.

*Collect in special tubes under oil.

Other reactions are (1) allergic, varying from urticaria to anaphylactic shock; (2) reactions caused by incipient coagulative changes; (3) reactions from pyrogens; (4) transmission of disease; (5) cardiovascular accidents, such as pulmonary edema, embolism or hemorrhage and thrombosis. In the face of symptoms pointing toward any of these reactions, the blood transfusion should be immediately discontinued. Pyribenzamine, 50 mg. every 4 hours, has proved beneficial in treating allergic reactions, such as urticaria, pruritus, etc.

Fluids Preoperatively

It is in the postoperative phase of management that we are chiefly concerned with fluid balance. However, it is just as important to establish and maintain an adequate fluid intake prior to surgery.

Unless one is particularly watchful for signs of dehydration, they may not be unduly noticeable. They are seen frequently in many patients with malignancy of the lower colon and rectum, more especially those who are obstructed or who have had chronic diarrhea and bleeding. Not infrequently, a lowering of the electrolytes, e.g., sodium chloride and potassium, etc., is also present.

Fluid balance is created and maintained by the administration of from 2,500 to 3,500 cc. of fluid daily. Should there be any evidence of serum chloride deficiency, the salt intake is increased. The urinary output is charted, and, when considered with the specific gravity, a rather accurate index as to body water balance is obtained. This is additionally valuable for comparison with the postoperative urinary output. Naturally, in those cases where obstruction is present, parenteral fluids are employed to establish and maintain fluid balance. For a more detailed discussion, the reader is referred to the section on postoperative fluid balance.

The weight of the patient is taken each day, serving as a guide to adequate fluid balance, as has been shown by Wangensteen. On the day of operation, 1,000 cc. of 5 per cent glucose in saline water are administered intravenously, from three to four hours prior to operation. This assures adequate fluids for the operative period and serves as nutrition for the immediate preoperative period. Such a regime in our experience, covering over 800 resections for various conditions has proved most satisfactory.

Preoperative Vitamin Therapy

That a high incidence of a subclinical type of avitaminosis, previously unsus-

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NAME AGE SERVICE OF
ADDRESS RESIDENT INTERN ADMITTED
DIAGNOSIS: OPERATION:

DATE									
ADMISSION									
OPERATION									
DIET	CARBOHYDRATE PROTEIN FATS								
FLUID INTAKE — ORAL	LIQUIDS								
FLUID INTAKE — ORAL	SULF NON AB								
FLUID INTAKE — INTRAVENOUS	BLOOD WHOLE								
FLUID INTAKE — INTRAVENOUS	BLOOD PLASMA								
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FLUID INTAKE — INTRAVENOUS	IN								
FLUID INTAKE — INTRAVENOUS	AMINO ACIDS								
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FLUID INTAKE — SUB CUT									
FLUID INTAKE — SUB CUT									
FLUID INTAKE — INTRA STERNAL									
FLUID INTAKE — INTRA STERNAL									
FLUID INTAKE	TOTAL								
CALORIC VALUE									
OXYGEN									
FLUID OUTPUT	URINE								
FLUID OUTPUT	EMESIS								
FLUID OUTPUT — DRAINAGE	WANGENSTEEN LOSS								
FLUID OUTPUT — DRAINAGE	BABCOCK SUMP								
FLUID OUTPUT — DRAINAGE									
FLUID OUTPUT	DIARRHEA								
FLUID OUTPUT	TOTAL								
WEIGHT OF PATIENT									
STOOLS									
BLOOD	W. B. C.								
BLOOD	R. B. C								
BLOOD	Hb								
BLOOD	HEMATOCRIT								
BLOOD	PLASMA PROTEIN								
BLOOD	UREA N								
BLOOD	PLASMA CHLORID								
BLOOD	PLASMA CO_2								
BLOOD	PH.								
BLOOD	PLASMA SP. GR.								
BLOOD	WHOLE BLOOD SP. GR								
BLOOD	VAN DEN BERGH								
URINE	CHLORIDES								
URINE	SP GR								

pected, but nevertheless a potentially dangerous state, may occur as a result of inadequate dietary intake, has been postulated by Kelly,[107] Youmans,[209] Spies[181] and others. Inability to utilize vitamins due to hepatic dysfunction has been demonstrated by Patek and Haig,[162] and additionally by the group working at the Memorial Hospital.[3] The failure of absorption of the fat-soluble vitamins in the absence of bile or

excessive use of mineral oil may be present. Increased vitamin requirements may be present in various disease processes, among which may be mentioned infections of the lung and the alimentary tract.[32]

Inadequate absorption of the water-soluble vitamin B-complex group, chiefly thiamin (b), riboflavin (b_2), pyridoxine (b_6) and nicotinic acid (amide). Pantothenic acid and biotin may be present, due to persistent vomiting and chronic diarrhea.

Many of the typical signs and symptoms of vitamin deficiency, such as anorexia, nausea and vomiting, flatulence, shifting abdominal pain, constipation, loss of skin turgor, xeroderma, pellagra-like skin lesions with discoloration, etc., with soreness, redness, with concomitant loss of papillae of the tongue, are also evident in patients with gastro-intestinal malignancy. Such are probably due to vitamin deficiency secondary to the malignancy and seem to initiate a vicious cycle, in so far as utilization and increased absorption are concerned.

In the last decade, interest in the use of vitamins, both preoperatively and postoperatively, has been steadily increasing and possesses a sound clinical basis. Numerous investigators have demonstrated vitamin deficiency in various surgical diseases and postoperative states. This added interest was chiefly aroused by the demonstration of their importance in wound healing by Lund,[124] Bartlett,[27] Kraybill,[115] Hunt,[95] Bourne,[38] Wolfer[204] and many others. Their investigations have resulted in the administration of vitamins postoperatively, yet they have demonstrated that vitamin deficiencies have existed, in all probability, for many months. It is the author's opinion that intensive preoperative vitamin therapy is of even greater importance in these cases, in order to build up a reserve which may be used by the body during the period of acute starvation following surgery.

Keys and Mickelsen[109] have called attention to the fact that certain sulfonamides may cause a vitamin deficiency state by their action in altering intestinal synthesis.

Vitamin "K." Dam *et al.*, in Copenhagen, demonstrated that a fat-soluble, nonsaponifiable and nonsterol fraction of hog liver or alfalfa cured or prevented a hemorrhagic diathesis in newly hatched chicks. He named this vitamin "K" (for koagulation). Subsequently, the chemical nature of these active members was discovered, and many synthetic naphthoquinones were prepared and tested. One of these was assigned the appellation of "Menandione" by the Council on Pharmacy and Chemistry of the American Medical Association; this synthetic was found to possess very high vitamin K activity.

This vitamin appears necessary for the formation of the normal amount of prothrombin by the liver. The latter substance is a constituent of the blood, essential for normal blood clotting. Prolongation of the clotting time definitely indicates a deficiency of this entity. Use of K vitamin has been of inestimable value in the therapy of hemorrhagic diathesis resulting from obstructive jaundice or in intestinal lesions interfering with vitamin K absorption. Occurrence of deficiency relevant to this vitamin, due either to inadequate intake or absorption from the intestinal tract and insufficient utilization, as in liver dysfunction, is very often demonstrable. Its administration has recently been employed quantitatively as a sensitive liver function test on the premise that an impaired liver will fail to increase prothrombin production when given standard amounts of vitamin K.

Not infrequently, the presence of hypoprothrombinemia occurs as a result of the presence of a malignant neoplasm in the large bowel and may be due to malnutrition, hepatic dysfunction or excessive loss of vitamins. Prothrombin time determinations, made on all patients preoperatively, are a routine procedure on our service, and even in the face of a normal reading, vitamin K is administered at four-hour intervals in 10 mg. doses prior to operation. Where it has been demonstrated that a de-

ficiency exists by prothrombin reading, repeated dosage is carried out until the values have returned to normal levels, before any surgical procedure is attempted.

Every effort is made preoperatively to overcome existing avitaminosis and to create a reserve. As a routine procedure, one multivitamin capsule, containing ascorbic acid, 100 mg., thiamin chloride, 5 mg., niacin amide, 50 mg., and calcium pantothenate, 5 mg., is administered three times a day. Where an apparent deficiency of vitamin B exists, 2 cc. of vitamin B-complex are given intramuscularly daily. Since there is usually present a deficiency of vitamin C, 500 mg. of ascorbic acid are administered intravenously until within three days of operation, at which time the dose is increased to 1,000 mg. In view of the excessive depletion of plasma vitamin A, 50,000 units of this vitamin are given orally twice a day during the preoperative period of preparation.

Hepatic Dysfunction

During the past few years, the importance of the liver in terms of surgical pathology has resulted from its concomitant involvement in gastro-intestinal malignancy, in which situation it may assume a more or less constant state of dysfunction. This has been shown to exist by numerous investigators, especially the group working at Memorial Hospital.[3] That this apparent dysfunction is closely related to this type of malignancy appears reasonable, because on removal of the growth the dysfunction clears up. This group concluded, as a result of their investigations of prothrombin, serum bilirubin, serum protein, vitamin A, glucuronic acid, mean corpuscular volume, urinary urobilinogen, cholesterol and cholesterol esters, that, taken as a whole, their findings represented an accurate index to liver function. In addition, they also believed that such factors as delayed wound healing, refractory anemia, hemolytic reactions in transfusions, hypoproteinemia and hypoprothrombinemia were associated with, and possibly due to, hepatic insufficiency. It has been demonstrated[145] that in normal individuals, anesthetics and manipulation of the liver[125] tend to induce hepatic insufficiency. As a result, it could be expected that those patients already possessing physiologically damaged livers would show these dysfunctions much sooner, with a corresponding failure to recover from their effects. Although in those patients undergoing surgery of the lower colon and rectum hepatic manipulation is not so important, quite frequently supplementary sodium pentothal anesthesia is administered, so that it is essential for them to have normal liver function to detoxify such agents. The importance of normal liver function in protein metabolism, maintenance of plasma vitamin A and prothrombin formation has already been discussed.

We attempted to work out a useful and satisfactory procedure on our service for determining liver function. In addition to the above-mentioned tests, we also employed the bromsulfalein, cephalin flocculation and alkaline serum phosphatase tests, but the results obtained were far from satisfactory, so that we were unable to duplicate the degree of liver dysfunction demonstrated by the Memorial Hospital investigators. Despite all this, we are still of the opinion that there is a definite degree of dysfunction present in those patients having gastro-intestinal malignancy.

Where marked weight loss, secondary anemia and hepatic enlargement with suspected metastases are present, even in those considered poor surgical risks, we still attempt to determine the liver function. Regardless of the outcome, an attempt is made to overcome any existing dysfunction by increasing the glycogen storage with high carbohydrate and protein intake, the use of synkayvite both preoperatively and postoperatively, use of large dosage of vitamin A and the correction of existing secondary anemia by transfusion.

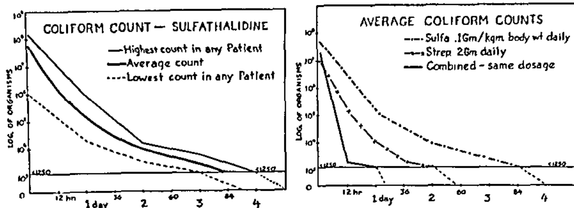
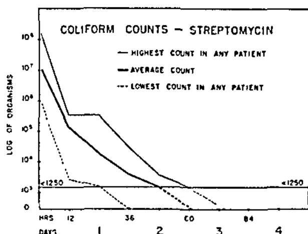


FIG. 720. H. E. Bacon and R. J. Rowe, J.A.M.A., 136:975, 1948.

An interesting side light to our studies has been the failure to obtain the reported increases in alkaline serum phosphatase observed by Bullard[39] in patients with massive liver metastases. In but a few of these was there any change in either the bromsulfalein or cephalin flocculation tests. The latter procedure, however, gave a positive 2 or 3 plus reading in more cases than did the bromsulfalein test.

The Preoperative Administration of Sulfonamides

Since the previous edition of this treatise, many useful adjuncts have been added to the list of therapeutic procedures in combating rectal and colonic malignancy. Of these, none have assumed the importance of that given to the sulfonamide group of drugs. Poth,[165] as early as 1940, began his experiments using the various sulfonamides in attempting to find one of them which could be employed to sterilize the gastrointestinal tract. The work was prompted by the knowledge that sulfanilylguanidine, which had been synthesized by Roblin *et al.*, and further studies made by Marshall, was poorly absorbed by the bowel. Poth began his investigations by using sulfaguanidine, first on dogs and then on humans. In the dog, large doses completely filled the pelvis of the kidney, while in humans, 50 per cent of the drug was excreted in the urine. It was additionally demonstrated that the drug failed to alter the coliform content of the gastro-intestinal tract in any significant degree where ulceration was present, and that it had been extensively absorbed from the bowel in both the dog and humans. In 25 per cent of the individuals receiving the drug at four-hour intervals, drug reactions of sufficient severity ensued to require discontinuance. (In all probability this may have been due to hypersensitivity of allergic origin.) In the interim, numerous other drugs were studied and discarded in a renewed search for a potent intestinal antiseptic. As a result, succinylsulfathiazole was synthesized (sulfasuxidine), as was phthalylsulfathiazole (sulfathalidine). The former had been introduced by Poth and Knetts,[166] while the latter was brought out by Poth and Ross in 1943.[167] Following the issuance of the first report, the use of sulfasuxidine was instituted and the results cited in 131 of our cases, of which 102 were abdominoperineal proctosigmoidectomies. An initial dose of 0.5 Gm. per Kg. of body weight was followed by doses of 0.25 Gm. per Kg. every four hours daily. Since 1944, sulfathalidine has been used routinely in a large series of cases with a very low mortality. Stools were obtained from a large number of these cases for a quantitative estimation of coliform organisms present.



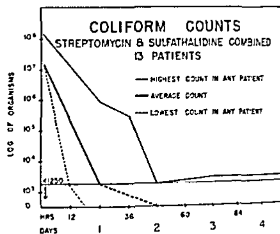
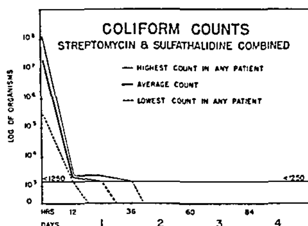


FIG. 721. (*Left*) H. E. Bacon and R. J. Rowe, J.A.M.A., 136:975, 1948.

FIG. 722. (*Right*) H. E. Bacon and R. J. Rowe, J.A.M.A., 136:975, 1948.



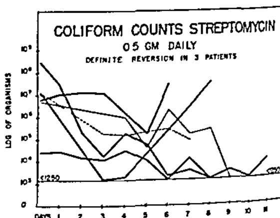


FIG. 723. (*Left*) H. E. Bacon and R. J. Rowe, J.A.M.A., 136:975, 1948.

FIG. 724. (*Right*) H. E. Bacon and R. J. Rowe, J.A.M.A., 136:975, 1948.

It has been our experience that 0.1 Gm. per Kg. of body weight, administered over a period of from five to seven days, is sufficient to reduce the coliform counts to an appreciably low level (1,250 organisms or less per Gm. of wet feces).

Since the introduction of these drugs in 1941 and 1943, many investigators pursued a study of them, extending their use and establishing their worth as intestinal and urinary bladder antiseptics. Pemberton[163] made the observation that mortality rates in colonic surgery had been appreciably reduced (from between 15 and 20 per cent to 5 per cent), with a concomitant increase in the resectability rate. He gave his opinion that this had been due largely to the use of chemotherapy. Sarnoff and Poth,[177] Poth and Ross,[168] Meyer and Kozoll,[144] Crohn,[55] Streicher,[186] Behrend,[28] Archer,[7] Dixon[55] and many more investigators have verified the value of these preparations in colonic surgery.

As to the relative value of the two drugs, various opinions for and against still exist. Sulfathalidine was found by Poth to be from two to four times as effective as sulfasuxidine in causing a reduction of coliform organisms. This was substantiated by its use in our own series of cases. As for toxicity, they were found to be relatively equal at equal dosage levels. Poth found but one recorded instance of a fatal agranulocytosis following use of sulfasuxidine. In

over 800 of the author's cases, no toxic manifestations were encountered from use of either drug. Some investigators, however, made mention of increased bleeding at operation following sulfathalidine therapy. Our personal experiences refute these findings. Prothrombin, bleeding and clotting time have not undergone any appreciable change, although, during postoperative periods, increased serosanguineous drainage from the perineal wound following abdominoperineal proctosigmoidectomy has occurred. Poth and others called attention to rather tenacious and stringy stools with a tendency to adhere to the bowel wall under sulfathalidine administration. Scarborough, in a personal communication to the author, stated that he had experienced the presence of this same phenomenon at operation. We have found this present in a few of our cases, especially where some degree of obstruction was manifested. Recently, we have been able to obviate this by the use of a low-residue diet supplemented by from 60 to 80 Gm. of protein concentrate or hydrolysate; and, as a result, we have usually found a very clean bowel at operation, even in the presence of partial obstruction. We have made use of this drug as an irrigation from four to six hours prior to operation in combination with a solution containing 10 Gm. of sodium bicarbonate and 6 Gm. of the drug. Poth still prefers sulfasuxidine, pointing to the 2,075 patients upon whom Bargen[22] used sulfasuxidine. Bargen also much prefers it to sulfathalidine. Poth also stressed the fact that, with the use of purgatives and enemata, sulfathalidine is superior to the other drug, but that the latter obviated the use of these procedures. We have experienced the best results when using 0.1 Gm. of sulfathalidine per Kg. of body weight, divided into six portions, one of which is administered every four hours.

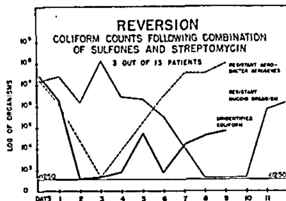


Fig. 725. H. E. Bacon and R. J. Rowe, J.A.M.A., 136:975, 1948.

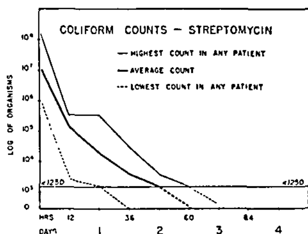
Streptomycin

This subject has been discussed under Postoperative Care, but it should be mentioned that a high concentration can be maintained in the intestinal tract which appears of value in preparing patients for colonic surgery. In conjunction with Professor Earl Spaulding, Head of the Department of Bacteriology, Doctor Rowe and the author[19, 211] explored the possibilities of streptomycin in this field. Indications are that 2 or even 3 Gm. orally daily may be necessary for proper preparation. In combination with the nonabsorbable sulfonamides, the results so far are very promising and, from our brief experience, are superior to the results obtained when either of the substances is employed separately. Our results[18, 19] are appended in the accompanying charts (Figs. 720 to 725 inclusive).

Intramuscular injections are best repeated at three-hour or four-hour intervals since the maximum levels are obtained within from one to three hours following a single injection. For our patients, we have used 2 Gm. of streptomycin in each 24-hour period (2 Gm. in 12 cc. water; dosage, 2 cc. every four hours). Our preliminary studies show that the combined use of these substances preoperatively should be limited to 48 hours.

Laboratory Determinations

Complete blood counts, which include hemoglobin determinations both in percentage and grams together with complete urinalyses, are routine examinations. Hema-



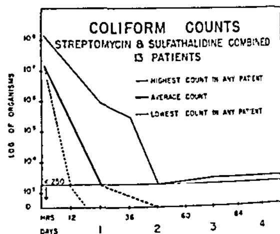
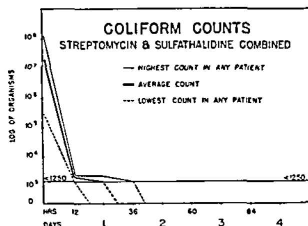


FIG. 721. (*Left*) H. E. Bacon and R. J. Rowe, J.A.M.A., 136:975, 1948.

FIG. 722. (*Right*) H. E. Bacon and R. J. Rowe, J.A.M.A., 136:975, 1948.



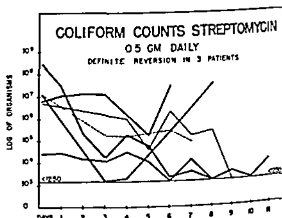


FIG. 723. (*Left*) H. E. Bacon and R. J. Rowe, J.A.M.A., 136:975, 1948.

FIG. 724. (*Right*) H. E. Bacon and R. J. Rowe, J.A.M.A., 136:975, 1948.

It has been our experience that 0.1 Gm. per Kg. of body weight, administered over a period of from five to seven days, is sufficient to reduce the coliform counts to an appreciably low level (1,250 organisms or less per Gm. of wet feces).

Since the introduction of these drugs in 1941 and 1943, many investigators pursued a study of them, extending their use and establishing their worth as intestinal and urinary bladder antiseptics. Pemberton[163] made the observation that mortality rates in colonic surgery had been appreciably reduced (from between 15 and 20 per cent to 5 per cent), with a concomitant increase in the resectability rate. He gave his opinion that this had been due largely to the use of chemotherapy. Sarnoff and Poth,[177] Poth and Ross,[168] Meyer and Kozoll,[144] Crohn,[55] Streicher,[156] Behrend,[23] Archer,[7] Dixon[55] and many more investigators have verified the value of these preparations in colonic surgery.

As to the relative value of the two drugs, various opinions for and against still exist. Sulfathalidine was found by Poth to be from two to four times as effective as sulfasuxidine in causing a reduction of coliform organisms. This was substantiated by its use in our own series of cases. As for toxicity, they were found to be relatively equal at equal dosage levels. Poth found but one recorded instance of a fatal agranulocytosis following use of sulfasuxidine. In

blood volume, CO_2 content, serum chloride, erythrocyte count, hemoglobin, hematocrit and the specific gravity of whole blood and plasma are essential determinations for the preoperative need of protein, fluids and become almost routine during and immediately following most abdominal operations. The Miller-Abbott tube, an outgrowth of original suction, has further widened the scope of intestinal intubation with continu-

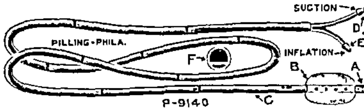


FIG. 726. Miller-Abbott tube.

blood. When there is a negative finding of bowel strangulation, it has been demonstrated that careful preoperative preparation, keeping in mind all these factors, has resulted in an appreciable reduction in mortality by the use of such simple procedures as cecostomy and transverse colostomy. Large amounts of glucose, saline, amino acids and whole blood are definitely essential requirements. While prolonged preparative measures are made on these patients, this is not always a wise procedure. Between 12 and 24 hours devoted to these essentials will usually enable the patient to withstand any necessary surgical procedure.

Preoperative Suction

It may be remarked without equivocation that no other one measure has contributed so much to preoperative and postoperative care of those undergoing abdominal surgery as the use of gastroduodenal and intestinal suction. Surgeons will for all time be indebted to Wangensteen for initiating and publicizing the use of the Levin tube and continuous suction for the relief of distention. The use of this procedure has assumed more importance than any other single factor acting to reduce mortality rates in large bowel surgery, not excepting the sulfonamides or antibiotics.

Wangensteen suction was originally employed in cases of intestinal obstruction, but its usefulness at the present time has

ous suction. Preoperatively, intestinal suction is confined almost exclusively to the use of Miller-Abbott tubes. The procedure is employed preoperatively with greater frequency in those cases where obstruction is located in the left colon. It may also be employed as a substitute for proximal enterostomy because its use has been popularized during recent years. In some instances, it has proved an adequate aid in decompressing the small bowel prior to operation for relief of left colonic obstruction and, in some cases, passes into the cecum and relieves large bowel distention. Conversely, we have had some rather disappointing results in this connection which have also occurred with the use of the Miller-Abbott tube as a substitute for proximal enterostomy or a complementary appendicostomy and cecostomy. Not infrequently, the ileocecal valve remains closed and the so-called closed-loop type of large bowel obstruction is present. In this instance, use of the tube may serve to endanger life. In conjunction with intubation, we did employ complementary appendicostomy, cecostomy or transversotomy at the time of resection with immediate end-to-end anastomosis, although recently it has been completely abandoned. One of the reasons advanced for this is that the tube becomes blocked or kinked even with constant attention to patency of the lumen, and it is to be remembered that distention of both

tocrit readings are determined together with serum protein and the A/G ratio. Both are obviously necessary. Blood volumetric determinations were begun, but the series is not large enough to permit of any definite or pertinent conclusions. It is our opinion, however, that they will aid in determining the actual status of the body proteins. No method yet devised seems capable of evaluating this status, and clinical judgment, at present, yields the only definite criteria.

All patients should undergo blood-urea and fasting blood-sugar determinations, but, due to the extremely heavy burden placed on the laboratory, these procedures have been restricted in some instances to those patients in the older group. Blood urea and N. P. N. determinations are also valuable in estimating kidney function.

We have ordered, as a matter of routine, a number of liver function tests, but these procedures have been discontinued in favor of a more practical use of them. We have reserved the procedures for those cases in which liver dysfunction has been suspected clinically. In those patients in whom parenchymatous damage is present or suspected, the cephalin flocculation and bromsulfalein tests are done for confirmation. Other tests necessary in determination of other phases of functional activity are the tests of prothrombin, serum bilirubin, van den Bergh, serum cholesterol and cholesterol esters, mean corpuscular volume of the erythrocytes, plasma vitamin A levels, urinary and fecal excretions of urobilinogen and urinary excretion of glucuronates. That of thymol turbidity is also used.

In those patients having had attacks of vomiting or excessive diarrhea, the carbon dioxide combining power or preferably content and serum chloride tests are also made. In the presence of normal hydration, these determinations, naturally, are not indicated preoperatively.

Blood sulfa level determinations are not made unless absorbable sulfonamides are administered.

Preoperative Consultation

Medical and urologic consultations are obtained on each patient prior to major surgery on the colon and rectum. The consultant in medicine is charged with examination of the cardiovascular system, and electrocardiograms are made as a matter of routine. Photofluorograms are done on each patient hospitalized, and in the event of any chest pathology, a 14 x 17 chest film is procured. The patient is also examined for possible factors predisposing toward the formation of thrombi. This procedure is followed postoperatively, as well.

Urologic examinations have proved to be of definite value, a fact that has been discussed by McCrae and the author.[17] Two additional routine procedures are cystoscopy and cystometrograms. The former are found useful in establishing the presence of invasion of the bladder, as well as prostatic hypertrophy or other pathologic processes referable to the urinary bladder. Cystometrograms are made for comparative purposes postoperatively.

Preoperative Management of Obstruction

There is a material departure in the management of the average case of colonic and rectal malignancy compared with those having obstruction. Assuming that the symptoms, signs and x-ray findings—flat plate and opaque enema—are indicative of the presence of this condition, surgical decompression, usually transversotomy, is instituted. Dehydration, hypoproteinemia, electrolytemia and avitaminosis are corrected. The emergency is not as acute as that occurring in the presence of obstruction higher in the bowel. An appreciable aid is the insertion of a Miller-Abbott tube to obtain decompression, particularly where the patient is not considered dangerously ill.

Alone, however, decompression is not effective in the large bowel, particularly in the presence of a closed-loop type of obstruction. In these cases, serum protein,

quately covering all phases of both preoperative and postoperative care of patients with major lesions of the lower bowel. It is the opinion of the author, however, that to outline the subject simply, placing particular emphasis on our present knowledge, based on fundamental principles and recent investigation, may be of value to the reader.

Our experiences in this respect, based on over 800 cases with rectal and sigmoidal cancer, as well as other lesions, such as diverticulitis, ulcerative colitis and inflammatory stricture, have been incorporated. For the purpose of clarity, various phases of postoperative management are discussed separately.

Fluid Balance Postoperatively

Of the factors involved in postoperative care, none is more important than fluid balance, and one should be ever mindful that abnormally large losses of fluid without replacement are incompatible with life. Appreciable losses of these substances, when permitted to pass uncorrected, may result in disturbed physiology that may prove fatal to the patient. For this reason, it is essential that the surgeon be acquainted with procedures requisite for correction of these pathologic processes. This knowledge has been one of the great factors in decreasing the mortality in operations on the colon and rectum during the past half decade.

The average individual consumes from 2,500 to 3,500 cc. of fluid during each 24 hours although this may vary from 800 to 3,000 cc. according to Latimer.[118]

Another source of water is food, since 70 per cent of the average food is composed of water. The average hospital maintenance diet yields from 1,000 to 1,500 cc. of water, while a soft diet yields but 500 cc.[48] The third source of water is derived from the oxidation of protein, carbohydrate and fat. One gram of protein yields 0.4 Gm. of water, 1 Gm. of carbohydrate, 0.6 Gm. and 1 Gm. of fat, 1.07 Gm.

Loss of fluids occurs through the kidneys, skin, lungs and the intestinal tract. The insensible fluid loss is that occurring from vaporization from the skin and lungs amounting to from 1,000 to 1,500 cc. daily.[51, 52, 77, 130] Body heat is dissipated by vaporization, which is unaffected by the amount of fluid intake or the availability of the latter. This means that it actually has priority over the kidneys on available fluids. Conversely, the amount of fluid excreted by the kidneys is markedly affected by the amount available. They excrete the waste materials in whatever amount of water remains after the other body processes are cared for. This, of course, may result in a large amount of urine with low specific gravity or a small amount with a high specific gravity, provided kidney function is normal. Obviously, then, an adequate urinary output is indicative of an adequate fluid intake. As an arbitrary standard, 35 Gm. of solid waste material has been accepted as the amount excreted daily by an average individual. Maddock and Coller,[130] using Lashmet's and Newburgh's[117] work as a basis, estimated the minimum amount of urine of various specific gravities necessary to excrete 35 Gm. of waste material from normal kidneys as 500 cc. of urine with a specific gravity of 1.030.

On the other hand, in diseased kidneys having a low concentrating capacity, 1,500 cc. of 1.014 or 1.015 specific gravity was required to excrete the same amount of waste material. This is estimated to be a minimum daily urinary output in all ranges of function. Latimer believes that one should strive for a minimum output of 1,500 cc. of urine daily. In our experience, this has been somewhat difficult. In most patients, this requires enough fluid to be dangerous in aged patients from the standpoint of overloading the circulation. The average patient requires from 3,500 to 4,500 cc. of fluid daily. Obviously this would allow very little time for the patient to rest. It has been our experience that a urinary output of 1,000 cc.

the small and large bowel can occur rather rapidly with constant stress on the suture line. Undoubtedly it is an excellent collateral procedure, but we consider its chief importance preoperatively to lie in its use in more or less acute obstructions and to deflate the bowel prior to surgical intervention.

It may be a fatal mistake, however, to persist in using suction for relief of the distention in the large bowel in the presence of obstruction. One should be mindful that no Miller-Abbott tube or Wangensteen suction will serve to relieve a severe obstruction of this type as adequately as surgical decompression.

Mention should be made here of the interoperative use of suction, for Wangensteen has asserted that this phase is of definite value in the prevention of vomiting, in the case of possible occurrence of subsequent pulmonary complications and with concomitant distention as a result of aerophagy during anesthesia.

We have invariably made use of the Levin tube as a routine procedure in all abdominal operations.

Miscellaneous Procedures

In the absence of obstruction, it is important to insist on the hospitalized patient remaining out of bed and continuing to take the usual amount of exercise. Fluid intake and urinary output are both charted, for this is essential in insuring normal fluid balance in preparation for extensive operative procedures. It serves additionally as a check and comparison of postoperative fluid intake and output and kidney function.

The weight of the patient in kilograms is obtained on admission and prior to operation and acts as a guide to adequate preoperative fluid balance and nutrition. In addition, it aids the physician in calculating drug dosage. In some instances, we have observed a corollary between the incidence of extensive metastasis and marked loss of weight.

The umbilicus of each patient is thoroughly cleansed daily for three days prior to operation and one of the mercurial tinctures applied. Recently, a new antibacterial agent, G-11, has been mentioned by Seastone, although we have had no experience with it at the time of this writing.

Vaginal douches of 1:8000 potassium permanganate are employed daily for three days preoperatively in all female patients.

We have been markedly impressed with the high incidence of multiple lesions found both at autopsy and in the resected specimens,[88, 135, 187] as recently reported by Dr. G. G. Broad and the author.[15, 16] Thirty-one and two-tenths per cent of our resected cancerous specimens disclosed concomitant adenomata, of which number 20.3 per cent were malignant. For this reason, a double-contrast enema study is ordered routinely for all patients unless obstruction is present.

CARE DURING OPERATION

As mentioned under Anesthesia, Chapter 26, our preference is fractional or continuous spinal, using 0.3 per cent pontocaine in 7 per cent dextrose solution. Patients submitted to radical extirpation routinely receive a minimum of 500 cc. of whole blood during the operation. If such is not obtainable, plasma is substituted. As can be appreciated, the circumstance of a suddenly depleted blood volume calls for immediate replenishment and the quickest and best means to accomplish increase in blood volume is by direct infusion of blood. As previously mentioned, duodenal suction applied to an indwelling Levin tube is in force during the operation to avoid vomiting and regurgitation of vomitus into the lungs, which, according to Wangensteen, is the most frequent cause of postoperative pneumonia.

POSTOPERATIVE MANAGEMENT

One is hesitant to undertake a discussion of such magnitude in limited space when volumes have been written without ade-

with a specific gravity of 1.015 is an ideal formula, and this is maintained in the average patient with a 2,500 to 3,500 cc. fluid intake. It may be observed therefrom that frequent urinary specific gravity determinations and daily intake and output records are essential for the determination of the status of body hydration. Of value is the comparison with the preoperative fluid balance and blood studies daily, such as plasma protein, specific gravity of blood plasma and whole blood, the cell volume of venous blood by the hematocrit, the daily weight of the patient (Wangensteen) and blood and plasma volumetric determinations when possible. Correct administration of fluids postoperatively may be determined by the above factors, but clinical evaluation of the degree of thirst, dryness of the skin and mucous membranes and capillary turgor are of import. By the foregoing, shock due to hemorrhage may be differentiated from that of circulatory collapse; and dehydration in the presence of anemia, fluid and protein loss and the onset of edema levels may be determined.

We have employed the McClure-Aldrich test,[137] which consists of measurement of the disappearance time of an artificially injected wheal of normal saline solution. The efficiency of this test, according to Appel and Brill,[6] as well as Hopps and Christopher,[92] has been proved through the investigations of Kunde.[116] The test represents a means of estimating tissue avidity for water. In 42 consecutive resections, it was thought to be a fairly reliable index to the state of hydration, provided the electrolyte equilibrium was taken into account. More recently, we have abandoned its use.

Electrolyte Balance and Salt Metabolism

Equilibrium of the electrolytic substances in the blood, particularly sodium chloride, cannot be divorced from fluid balance, because electrolyte loss occurs as a result of loss of fluids containing these substances. An understanding of this equilibrium is necessary since surgical procedures on the large bowel are frequently attended by abnormal losses of these substances. Under normal conditions, the electrolyte concentration of the intracellular and extracellular compartment does not result in changes in electrolyte concentration. Marked depletion in the extracellular reservoir of base and water results in a fall of total base concentration in the plasma. In patients who have undergone abnormal loss of fluid containing electrolytes, the relative proportion of acid and basic constituents should be known, as well as the total base concentration, in order to combat acidosis or alkalosis which may ensue in addition to dehydration. The normal daily salt requirement, as estimated by different authorities, varies from 1 to 10 Gm.,[25, 206] so that 4 or 5 Gm. may be accepted as the average. Sherman[179] has estimated the total salt content of the body as 15 per cent of the body weight, expressed in terms of chlorides, or 0.248 per cent of the body weight expressed as sodium chloride. The total sodium chloride content of a person weighing 60 Kg. would be 148.8 Gm.

Sodium chloride has two main functions in the body. As an electrolyte, it aids in maintaining the acid-base balance of the body by its sodium (Na^{+}) and chloride (Cl^{-}) ions. Its other function is to aid in the distribution of body fluids and in the regulation of their amounts by its influence on osmotic pressure.

Normally the chloride content of the blood, expressed in terms of sodium chloride, is from 450 to 500 Gm. per 100 cc. of blood. As plasma sodium chloride, the values are from 550 to 630 mg. per cent, and the plasma chloride, from 350 to 380 mg. per cent.

Sodium chloride is excreted through the skin, feces and urine. Approximately 0.5 Gm. is excreted normally by way of the skin and feces, the remainder passing out in the urine, which may contain 2 per cent salt. This usually amounts to 3 Gm. of sodium chloride daily in an individual who is in sodium chloride balance.[196]

TABLE 91

TEMPLE UNIVERSITY HOSPITAL
DEPARTMENT OF PROCTOLOGY

FLUID BALANCE

Service of					Resident				Intern		D. Nurse N. Nurse		
	NAME						DATE						
Disappearance Time	PREOP.	P. O. 1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
MIN.													
70													
60													
50													
40													
30													
20													
10													
SKIN													
TONGUE													
VENOUS COLLAPSE TIME													
Edema													

Table 92. Treatment Outline (Moyer)

Fluid Volume State	Repair Solution	Concentration of Solute Repair Solution	Composition of Repair Solutions — Compositional Change in Extracellular Fluid: Alkali Normal Alkali Deficit[1] (Minimal-moderate)	Composition of Repair Solutions — Compositional Change in Extracellular Fluid: Alkali Excess[1] (Minimal-moderate)
Acute water deficit Chronic water deficit	Glucose in water	5, 10, or 15%		
Extracellular salt water deficit with water deficit	Sodium salts	100 mEq /liter*	Sodium chloride plus sodium bicarbonate (or lactate) plus potassium chloride. Ratio NaCl : $NaHCO_3$: KClmEq 4 : 1.0 : 0 166	Sodium chloride
Water excess	Sodium salts	180 to 360 mEq./liter	Sodium chloride plus sodium bicarbonate (or lactate) plus potassium chloride. Ratio NaCl : $NaHCO_3$: KClmEq 4 : 1 0 : 0.166	Sodium chloride
Extracellular salt water deficit with relative water excess	Sodium salts	160 to 250 mEq /liter	Sodium chloride plus sodium bicarbonate (or lactate) plus potassium chloride. Ratio NaCl : $NaHCO_3$: KClmEq 4 : 1 0 : 0.166	Sodium chloride
Extracellular salt water distributional shifts	Sodium salts	100 to 160 mEq./liter	Sodium chloride plus sodium bicarbonate (or lactate) plus potassium chloride. Ratio NaCl : $NaHCO_3$: KClmEq 4 : 1 0 : 0.166	Sodium chloride
Extracellular salt water excess with or without a relative water deficit	Glucose in water	10 to 15%		

* Salt dissolved in water or in 5 per cent glucose solution.

1 When disturbed fluid volume states coexist with severe compositional disturbances, the initial treatment should be directed toward the correction of the alkalosis or acidosis. In the treatment of alkalosis, M/100 HCl or a 0.9 per cent solution of NH_4Cl is effective. In the treatment of severe acidosis, sodium bicarbonate (1.3% solution) or sodium lactate (M/6 solution) may be used. When the signs of shock or liver damage are present, sodium bicarbonate is to be preferred to sodium lactate because the latter may not be split by the liver of a person who is very ill; and if it is not split, it is not effective in the treatment of acidosis.

The amount of acid or alkali to be employed in the initial treatment of a base bicarbonate deficit or excess may be determined as follows:

(1) In the treatment of acidosis, use 60 mg. of sodium bicarbonate per kilogram of body weight as a 1 3 per cent solution for each mEq the base bicarbonate is below 25 mEq per liter of plasma. The amount can also be obtained without calculation by the use of Van Slyke's nomogram The employment of this formula to calculate the base bicarbonate needed to correct a given base bicarbonate deficit will provide enough $NaHCO_3$ to replenish both the intracellular and extracellular deficits.

(2) For the initial treatment of alkalosis, employ the following rule. Take 0 063 cubic centimeter of concentrated HCl (36 per cent) per kilogram of body weight for each mEq. the base bicarbonate is above 30 mEq. per liter of plasma; dilute it with 0 9 per cent NaCl solution so that not more than 5 cubic centimeters of concentrated acid is present in 100 cubic centimeters of saline; then give it slowly and stop the injection if dyspnea appears.

If the necessary laboratory data are not available, changes in physical signs may be used in regulating the amount of sodium bicarbonate or hydrochloric acid to be given. In the case of severe acidosis, sodium bicarbonate solution (1.3 per cent) may be infused intravenously until the hyperpnea and the dyspnea are relieved; usually in an adult two liters of 1 3 per cent $NaHCO_3$ will be enough. With severe alkalosis, M/100 HCl or 0.9 per cent NH_4Cl may be given until the carpopedal spasm and the hypopnea are relieved.

After the initial correction of the compositional abnormality, the extracellular salt water deficit that remains is corrected with appropriate solutions. The extracellular salt water deficit associated with acidosis or alkalosis (excepting alkalosis due to the ingestion of alkali) is almost always relatively greater than the alkali excess or deficit, and therefore after the initial correction of the compositional changes, more salt solution of a relatively neutral reaction should be given to correct the extracellular salt water deficit that remains.

Moyer: Surg., Gynec. & Obst. 84:595, 1947.

Salt Metabolism in Disease. Abnormalities may occur in salt metabolism from inadequate intake, excessive loss or excessive administration. Where intake is greater than requirement, most of the excess is excreted in the urine. In health, this is easily accomplished, but in a sick surgical patient, an excessive intake may produce edema, as the kidneys cannot excrete the excess so efficiently.[50] In combination with hypoproteinemia, excessive intake produces edema even more quickly, with a resultant hydremia and not hyperchloremia.

Abnormal salt losses occur through excessive perspiration, continuous gastroduodenal suction, vomiting, diarrhea, intestinal or biliary fistulae, or in any other condition in which body fluids are lost. The amount lost in these fluids may be calculated, thus serving as an index to body salt requirement. These abnormal losses result, first, in a fall of blood chlorides—hypochloremia—and, second, in a depletion of the body chlorides in general. This often is followed by alterations in the acid-base balance, and commonly there is an increase in the blood nonprotein nitrogen as a later manifestation.

In prolonged vomiting or gastric and duodenal intubation, there is an excessive loss of the chloride ions which soon results in alkalosis. Conversely, excessive loss of the sodium ions is followed by an acidosis. Partial compensation for the former condition is accomplished by adequate fluid intake. The loss of the sodium ion can only be compensated by actual replacement with sodium chloride. Abnormal salt losses may also occur through excessive perspiration, diarrhea or intestinal fistulae, or in any condition where there is a loss of the body fluids. Coller and Maddock are of the opinion that these losses should be measured whenever possible and, as they contain a fairly constant amount of salt per liter, correction must be made in the daily calculation for fluid requirement. Since none of these fluids contain more than 5 or 6 Gm. of salt per liter, they may be satisfactorily replaced with normal saline solution, volume for volume. It would seem logical, then, to replace the amount of body fluids lost with varying amounts of physiologic saline which is done routinely in our cases.

In 1945, in a detailed study of the electrolytic substances and water balance postoperatively in patients undergoing abdominoperineal resection, Coller and his coworkers again demonstrated the fallacies resulting from excessive administration of sodium chloride postoperatively. The injection of "isotonic sodium chloride" solutions was attended by an average retention of 53 per cent of the sodium, 48 per cent of the chloride and 19 per cent of the water 30 hours following surgery. Coller believed that this represented a loss of approximately two liters of fluid from the intracellular compartment in order to maintain isotonicity. Conversely, infusions of hypotonic solutions resulted in the average retention of 27 per cent sodium, 32 per cent chloride and 39 per cent of the water during the same period. The authors concluded that the extra water was available for excretory function of the skin and lungs without affecting the intracellular compartment. They recommended the use of hypotonic solutions, 0.45 per cent NaCl or better, and 0.38 per cent NaCl + 0.11 per cent $NaHCO_3$ for intravenous infusion during the first two postoperative days to replace excessive loss of fluids. Moyer[149] has also called attention to the fact that excessive administration of salt is harmful.

Limbert *et al.*[123] found a retention of sodium in five out of six postoperative patients to whom parenteral sodium chloride had been administered. They emphasize the fact that water administered in the form of physiologic saline solution is not available for the important requirements of evaporation and perspiration. In our department, for over a period of three years, we have used an average of 1,000 cc. "isotonic saline," 9 Gm. per liter of solution with 5 per cent glucose in distilled water as the supplementary solution to insure an intake

internal exudates and transudates and from any pathologic condition of the skin that causes oozing or desquamation. Losses from the intestine may be from diets containing large amounts of roughage. Protein losses from the kidney may occur following trauma or infection with increased protein catabolism.

According to Lund and Levenson,[127] a large output of nitrogen may occur in the urine for many days or weeks following acute trauma, poisoning, infection or even unusual exercise of an extreme nature. Surgical and traumatic shock does not necessarily form part of this picture. Elman[78] found protein loss to be high (as much as 25 Gm. per day) following surgical procedures of any magnitude. Important losses occur from wounds with large surfaces, such as those perpetrated in abdominoperineal resections. Co Tui, Wright *et al.*[189] measured rather large losses from wound exudates and from tube drainage of the upper gastro-intestinal tract. Casten[45] found hypoproteinemia to be associated with anesthesia. Although the studies have not been carried far enough to determine just how this loss occurs, he found a steady reduction in the plasma protein level with any anesthetic agent. If the liver function was impaired preoperatively, a reduction of plasma protein followed, even after short operations. Lund and Levenson[127] have discussed the results of protein deficiency in surgical patients, pointing out that edema definitely occurs following extreme protein depletion and that, even in a depletion of lesser severity, there is an interference with wound healing and gastro-intestinal function.

Jones and Eaton[102] first focused attention on the importance of protein nutrition in the surgical patient by showing that edema due to hypoproteinemia was common in patients prior to and following gastro-intestinal surgery, and that it was usually associated with a prolonged and inadequate food intake. Thompson and Ravdin[189] have asserted that localized edema at an operative site may occur without the edema becoming generalized; this is of particular importance in intestinal anastomosis. Meyer and Kozoll[143] have also reported poorly functioning anastomoses due to the same causative mechanism. If hypo-albuminemia is present, it should be corrected, since this is associated with poor wound healing and wound disruption.

Manifestations of Hypoproteinemia. Hypoproteinemic edema occurs in surgical patients only when protein depletion is severe. However, depletions of lesser severity may cause interference with wound healing and with gastro-intestinal function prior to and following operation. It has been shown by several investigators[101, 143, 170, 188] that edema in the stoma of gastric cases occurs in the presence of hypoproteinemia. This also will occur at the site of any intestinal anastomosis. Koster and Shapiro[114] have also stressed the importance of protein deficiency and wound healing.

Reduction in blood volume is associated with hypoproteinemia. The latter condition, when present, predisposes the patient to shock, where a reduced blood volume is also a factor. Elman[68] recently has shown that, in the presence of hypoproteinemia, shock will ensue from very slight loss of blood and that, following such loss, a great decrease in the already low plasma concentration occurs.

Madden[129] showed that hypoproteinemic dogs were very susceptible to infection and that, once the infection developed, the production of plasma protein was markedly diminished. Cannon[43] found that the production of antibodies in hypoproteinemic rats was greatly decreased. The author pointed out correlations to this condition in clinical cases and concluded that the occurrence of postoperative infections, pulmonary complications, etc., depended to a large extent on the titer of immune substances in the body, which, in turn, depended on the nutritional status of the patient.

The liver plays a most important role in protein metabolism and, in the presence of protein depletion, loses protein, decreases

of from 2,500 to 3,000 cc. of fluid during a 24-hour period.

Sodium bicarbonate or sodium lactate, *blood and plasma are employed as indicated*, depending on the carbon dioxide content of the blood, the serum protein, hematocrit, blood specific gravity, erythrocyte count and hemoglobin.

It was of interest to note the cases studied by Coller. They showed large amounts of serum lost from the posterior wound in the Miles' abdominoperineal resection. The use of plasma and blood was essential to correct these losses. Unless there has occurred excessive loss of fluids from the Wangensteen suction, the Babcock abdominal sump or the posterior wound, 9 Gm. of salt daily has maintained an adequate serum chloride level.

Recently, since salt intolerance has been noted by various authors, a closer check on our patients has revealed a rather marked rise in the urinary output on the third and fourth postoperative days after discontinuance of intravenous fluids. This may or may not have significance. Certainly, in the face of the recent investigation, it seems wise to minimize the salt intake and administer it preferably in the strength advocated by Coller.

It has been our experience that from 2,500 to 3,000 cc. of fluids administered to the average case as is shown in the previous chart have provided an average urinary output of 1,000 cc. with a specific gravity of 1.015. The latter has proven to be the most practical index of fluid balance. Determination of the amount and specific gravity of the urine, the hematocrit, erythrocyte count, hemoglobin, blood and plasma specific gravity and the serum proteins advocated by Drew and Scudder[91] have proved of definite value, although, more recently, attempts have been made to discredit these procedures.

In combination with frequent serum chloride, carbon dioxide combining power and daily urinary specific gravity and *p*H determinations, adequate fluid and electrolyte balance may be maintained in the average patient. In the group of seriously ill individuals, such as those with prolonged *vomiting from obstruction, paralytic ileus* from peritonitis, small bowel fistulae and severe ulcerative colitis with or without ileostomy, it is also necessary to follow the patient more closely with daily total urinary chlorides, blood *p*H, and volumetric determinations with blood sodium and potassium levels.

The chart on page 997 depicts a representative list of orders which are carried out on patients undergoing abdominoperineal *proctosigmoidectomy* or any type of resection. As a general rule, peristalsis returns in from 24 to 36 hours. When this becomes audible, the gastric suction tube is clamped at intervals of from 30 minutes to one hour and the patient given water *with the tube clamped. If tolerated*, the tube is permitted to remain clamped off and is removed usually at the end of a period from 36 to 48 hours postoperatively. Usually on the third postoperative day, but preferably the afternoon of the second day, the patient is placed on a diet containing low-residue solid foods, including white meat of chicken, broiled steak or lamb chops. Should this be well tolerated, full diet is instituted on the fourth postoperative day. Quite frequently, on the third or fourth postoperative days, the serum proteins and blood will reveal a rather sudden drop in the former and a decrease in the erythrocyte count which must be compensated by the administration of blood or plasma or both.

Clinical Manifestations of Protein Deficiency

It is now well established that the body proteins are depleted by various disease processes. Quite frequently these diseases are superimposed on an already *deficient* protein reserve resulting from inadequate protein diets. Proteins may also be lost from the intestine, through the kidneys, from any wound or orifice of the body, in

cally, however, the plasma protein with its A/G ratio, the status of the patient's hydration, weight, etc., will offer a good index of the condition of the body proteins. Postoperatively, the total plasma protein must be depended upon, because the plasma volume as determined by the T-1824 dye, after the method of Gregerson and Stewart,[83, 84] is rather difficult to determine routinely. The relative changes of albumin and globulin are also factors of importance. The changes in protein nutrition as a whole are reflected more sensitively by variations in the serum albumin. Under conditions of protein starvation, Weech[197] has demonstrated that there is a steady fall in serum albumin concentration of the plasma, whereas the globulin level is hardly disturbed. That this fall reflects a depletion of the protein stores of the entire body has been clearly demonstrated by a number of workers.[70, 128] Elman[67] and his co-workers have calculated that a reduction of 1 Gm. in the total circulating plasma albumin indicated a loss of 30 Gm. of body protein.

Maintenance of a Positive Nitrogen and Fluid Balance. In attempting to maintain nitrogen balance postoperatively, a number of factors have been encountered which make this a difficult problem. If salt is excluded, as well as carbohydrate and fat metabolism, the influence of hypertonic solutions, rate of fluid administration, comfort of the patient and the daily fluid intake, the administration of proteins in the form of plasma and amino acids for maintenance of a positive nitrogen balance would be extremely simple. Practically, however, this cannot be done. It has been our purpose to approach the subject of nutrition in terms of the patients themselves from a more practical standpoint, postoperatively. Ideally, from 1.0 to 1.5 Gm. of protein per Kg. should be ingested daily. This will also require approximately 2 Gm. of carbohydrate for each gram of protein in order to insure proper metabolism of the protein. In fact, 2 Gm. of protein per kilo would be preferable in the more severe cases of protein depletion, with a concomitant increase in carbohydrate intake. We have employed a similar regimen in our resections which provides approximately 60 Gm. of protein, from 100 to 150 Gm. of carbohydrate and 9 Gm. sodium chloride daily.

In our experience, this has proved satisfactory for maintaining an adequate fluid and nitrogen balance. Some criticism might be advanced in connection with the use of hypertonic solutions and excessive sodium chloride. It does seem apparent from Coller's work that a "salt intolerance" is present during the immediate postoperative period. However, it is to be remembered that, not so long hence, this investigator advocated the use of much larger amounts of saline, while at present he recommends its use in strengths of from 0.38 to 0.45 per cent.

We have found the use of protein hydrolysate as parenamine (6%) or amigen (5%) to be adequate to maintain nitrogen balance. Reactions have been practically nil with these solutions, and they can be administered fairly rapidly with no untoward effects. Plasma is also a useful adjunct in restoring depleted plasma proteins. The latter condition is encountered infrequently when the above regime is followed. Occasionally, however, the serum protein levels will drop below 6.5 per cent, and in these cases one unit of plasma is given for approximately each 0.5 Gm. decrease below this level. The daily intake of parenteral amino acids is also doubled.

As soon as the patient is able to take liquids by mouth, a high protein diet is reinstituted. using the same supplementary aids, delcos granules, or essenamine, that were employed preoperatively.

Sulfonamides Postoperatively

General Considerations. Chemotherapy undoubtedly has played an important role in reducing the mortality and morbidity attendant on surgical procedures involving the colon and rectum. As in other phases of preoperative and postoperative management

in size and becomes soft.[13, 69, 159] Madden *et al.*[128] have also stated that a traumatized liver cannot manufacture albumin or prothrombin as well as a normally functioning organ. Abels *et al.*[3] *demonstrated that 88* per cent of patients with gastro-intestinal malignancy had abnormally low levels of vitamin A. In the majority of these patients, these levels were considered to be due to an inability of the organs of the patients to store the vitamins and to distribute them properly. By the use of other tests these investigators concluded that the same patients showed a very high incidence of hepatic dysfunction. Mulholland[150] and others have demonstrated the relation of hypoproteinemia to decubitus ulcers, only two instances of which have been observed in our cases.

Hypoproteinemia in Patients with Malignancy of the Lower Bowel. As was pointed out heretofore, Jones and Eaton were among the first to note that hypoproteinemia was common in patients with gastro-intestinal cancer. Hartzell[96] found it to be of frequent occurrence among general surgical patients. As previously reported,[12] we found that 22 out of 74 consecutive patients (29.7 per cent) with cancer of the sigmoid and rectum had hypoproteinemia with levels of less than 6.5 Gm. per cent on admission to the hospital. Similar results were obtained by Meyer and Kozoll,[143] who observed that 29.3 per cent of patients with gastro-intestinal cancer were hypoproteinemic. Binkley[34] and his associates, in 1943, found that 23 patients out of 65 (36 per cent) had a plasma protein deficiency below 6.5 Gm. per cent. Of this group of 65, 60 of the patients had apparently maintained an adequate protein diet.

Postoperatively, Meyer and Kozoll observed that protein deficits were excessive in cases of colonic cancer. Binkley found that 56 of 65 patients (86 per cent) became hypoproteinemic (levels below 6.5 Gm. per cent). In our own series of cases, 17 resected patients in whom no treatment was instituted were taken as a control. *Fifteen, or* 88.2 per cent, became hypoproteinemic (6.5 Gm. per cent or above the level considered normal). In contrast, however, were 57 unselected patients with cancer of the rectum or *sigmoid, in whom postoperative hypoproteinemia* was anticipated and an effort made *to attain and maintain* nitrogen equilibrium by the administration of blood, blood plasma and amino acids in liberal amounts. Fifteen of the 57 (27 per cent), following abdominoperineal proctosigmoidectomy, showed serum protein levels below 6.5 Gm. per cent. Ariel[9] and others have observed the same *fall postoperatively in* patients with cancer of the gastro-intestinal tract.

Estimation of Hypoproteinemia. An accurate determination of the status of the tissue and plasma protein in the surgical patient is rather difficult but most important, both pre- and postoperatively. There is an increasing mass of evidence which *shows that plasma proteins reflect* changes in protein nutrition of the entire body. These changes, however, do not occur early, since the plasma proteins are maintained at a normal level at the expense of the tissue proteins. Clinical observation reveals that many patients with cancer of the lower bowel are *obviously malnourished* and anemic, yet they show *normal plasma* values. It is evident, then, that even small deficits in plasma proteins are very significant but many times do not reveal the true picture of the patient's nitrogen *balance*. Other factors necessary for a critical *analysis of the body proteins* are (1) the optimum weight of the patient, (2) the actual weight, (3) total plasma protein, (4) plasma albumin and globulin, (5) R. B. C., hemoglobin and hematocrit, (6) nitrogen intake and (7) nitrogen output.

Taking all of the above factors into consideration, *it still is* difficult to estimate the status of the nitrogen balance. Abbott and Mellors[1] have demonstrated that the plasma levels may be normal when a relatively large deficit of the total red cells or *the total circulating plasma* exists. Practi-

cutaneously in the strength of a 1 per cent solution in normal saline. One half of the total calculated 24-hour dose is given initially and the remainder in two doses at 8-hour intervals.

Sulfapyridine. Use of this drug has been almost completely abandoned due to its toxicity and the attendant renal complications following its use.

Sulfathiazole. This drug is only one tenth as soluble as sulfanilamide but is rapidly absorbed from the gastro-intestinal tract, with maximum concentrations in the body being reached in from three to six hours. However, it is excreted with equal rapidity by the kidneys except in the presence of renal impairment, so that the maintenance of adequate blood levels is somewhat difficult to attain. Urinary complications, when present, occur in the form of both gross and microscopic hematuria, azotemia and anuria. This pathology may be due to the formation of acetylsulfathiazole crystals or possibly to the direct effect on renal epithelium. It is necessary, therefore, that an adequate urinary excretion of at least 1,000 cc. in each 24-hour period be maintained. It is our custom not to administer this drug postoperatively unless the urinary output reaches this level. The drug is especially useful in staphylococcic infections and those of the urinary tract due to *Escherichia coli.* In chronic staphylococcic infections, it is essential to establish adequate drainage concurrently with the administration of the drug.

The initial dose given to adults should be 4 Gm., followed by 1.0 Gm. every four hours, day and night. In diffuse staphylococcic cellulitis or lymphangitis, 4.0 Gm. should be given as an initial dose, followed by dosage of 1.5 Gm. every four hours, day and night, just as long as evidence of a spreading infection continues. For bacteriemia, the same dose will suffice for 48 hours, following which the dosage may be reduced to 1.0 Gm. every four hours. In the severe types of stapyhlococcic infections, the initial dosage should be calculated on the basis of 0.2 Gm. per kilo of body weight up to and including 20 Kg. The total daily dose is calculated on the same basis, divided into 6 doses and given at 4-hour intervals. The drug is much more efficacious when administered *per oram,* since it is only slightly soluble. Where this is impossible, it may be used in the form of its sodium salt. In a large series of cases, we employed this drug routinely in 5.0 Gm. doses daily, divided into 2.5 Gm. doses given at 12-hour intervals. Very satisfactory results were obtained. This form has been used for infections such as peritonitis, pelvic abscess and the like. For pulmonary complications it has been replaced by the less toxic sulfadiazine.

Sulfadiazine. This is the most widely used of the sulfonamide group since it is less toxic and more effective in a greater variety of infections. It is less toxic than sulfathiazole and, although readily absorbed from the gastro-intestinal tract, it is excreted very slowly.[164] It readily diffuses into the body tissues and fluids and is highly efficient in pneumococcal, streptococcal, staphylococcal and meningeal infections and acute urinary tract infections due to *E. coli.* It is ineffective in the presence of *B. proteus.* The drug induces less nausea and other side reactions. The precipitation of acetylsulfadiazine crystals in the urinary tract may be largely avoided by the administration of sufficient alkali orally to maintain an alkaline urine. One group has stated[80] that the amount of acetylsulfadiazine and sulfadiazine dissolved in urine with a *p*H of 7.5 is twenty times greater than in urine with a *p*H of 5. The recommended dosage of sodium bicarbonate varies from 12 to 24 Gm. daily.[100, 173] In our experience, doses of 1.0 Gm. every four hours have sufficed to maintain a slightly alkaline urine. The question of a direct nephrotoxic effect has also been raised recently, entirely aside from that of alkalinization. In cases of cardiac decompensation, Ohnysty and Wolfson[100] suggested the daily administration of 12 Gm. of potassium bicarbonate to avoid the

of cancer of the lower bowel, military medicine has advanced our knowledge of sulfonamide medication. In the treatment of postoperative complications, such as pneumonia, peritonitis, urinary and wound infections, an excellent opportunity has been afforded for clinical evaluation of the prophylactic administration of the drugs intraperitoneally and locally in the presence of gross contamination.

It is not the purpose of the author to discuss in detail these drugs since most readers are familiar with the history from their inception. Domagk's work, in 1935, treats of this phase, and, in addition, everyone is aware of the more useful drugs which have been derived as a result of multitudinous studies by various investigators in this field. The most commonly used drugs are sulfanilamide, sulfathiazole, sulfadiazine, sulfasuxidine, sulfathalidine, sulfapyridine and sulfamerazine.

It is of basic importance to understand that these substances possess different properties as well as bacterial specificities. An understanding of the latter is essential to a rational approach to their use from a clinical standpoint. Not only must the organism causing the infection be taken into consideration, but also the renal function, age and toxicity in the selection of a suitable drug. Other important factors relative to this selection are rapidity of absorption and excretion and the degree of acetylation.

There are few contraindications to the use of these drugs, but the most important one to be considered is impaired renal function. It is definitely mandatory that the latter function be within normal limits and that an adequate urinary output be maintained during administration of these drugs. It might be mentioned *en passant* that daily specimens of urine must be examined microscopically for the presence of erythrocytes and sulfone crystals. This should be done in all cases, just as frequent blood level determinations of the drug used must be made. It is still customary on our service to administer sodium bicarbonate in conjunction with sulfonamide dosages where the drug is given orally.

The sulfonamides which are of value postoperatively may be divided into two groups: (a) those readily absorbed from the intestinal tract, such as sulfanilamide, sulfathiazole, sulfadiazine and sulfamerazine, and (b) those which are poorly absorbed and whose action is largely limited to the intestinal tract, such as sulfasuxidine and sulfathalidine. The poorly absorbed or nonabsorbable sulfonamides (sulfasuxidine and sulfathalidine), have been discussed under Preoperative Management; the absorbable sulfonamides, however, deserve brief consideration. It should be stated that prior to 1945 sulfanilamide and later sulfathiazole were administered parenterally in all our cases following resection. Since that time neither has been used unless specifically indicated.

Sulfanilamide. This was the first sulfonamide to be used widely in this country and is still valuable in treating certain types of infection. It is absorbed rapidly and diffuses with equal celerity into the body fluids and tissues. Ninety per cent of the drug is excreted through the kidneys, and it is important to realize that the amount excreted is directly proportional to the urinary output. It is necessary to adjust the intake of the drug and fluids essential to maintain adequate blood levels, as well as to guard against excessive retention of the medication. In patients with normal kidney function, the drug is completely excreted within 48 hours following the terminal dose administered.

The drug is exceptionally useful when administered in cases of hemolytic streptococcal infections, but it is more toxic and hardly more useful than is sulfadiazine. Blood levels of from 10 to 15 mg. per cent are very effective even in the bacteremias.

The drug is administered in an initial dosage of 0.10 Gm. per Kg. of body weight, is divided into 6 equal doses and is best administered orally but may be given sub-

gross contamination have occurred from perforation during mobilization or slipping of the clamp in anastomoses.

Use of Sulfonamides Intraperitoneally. In older individuals, extreme caution should be used in the administration of sulfonamides. Prior to 1945, we encountered five cases of jaundice postoperatively following the intraperitoneal use of 5.0 Gm. of sulfanilamide. Since that time, 2.5 Gm. of sulfathiazole or preferably sulfanilamide are insufflated intraperitoneally following resection. Daily urinary examinations are made for the presence of sulfone crystals, and blood sulfone levels are estimated frequently where the drug is continued postoperatively.

Antibiotic Agents

The existence of these agents has been known for an extended period, but not until 1929 was penicillin discovered by Fleming,[74] working at St. Mary's Hospital in London. Pasteur and Joubert, as long ago as 1877, discovered that certain air-borne organisms inhibited the growth of anthrax bacilli, and they even suggested that this phenomenon of antibiosis might be useful in the treatment of certain infections. Emmerich and Low, in 1899, made the first attempt to apply this principle when they used a substance called "pyocyanase," derived from the *Pseudomonas aeruginosa* (*Bacillus pyocyaneus*), and inhibited the growth of diphtheria, cholera, typhoid and plague organisms. Dubos isolated the first useful and purified antibiotic, tyrothricin, in 1939.[62, 63, 93, 150] In 1940, co-operative investigation under the leadership of Sir Howard W. Florey at the Sir William Dunn School of Pathology at Oxford, England, resulted in the isolation of penicillin in a form suitable for clinical use. Production of this substance on a large scale was begun by American firms, which resulted in an abundance of supply at relatively low cost. A number of other antibiotic substances have been isolated, but, so far, the most useful of these are streptomycin and tyrothricin.

Waksman, Woodruff and Horning[192, 193] mentioned a new substance, in 1941, which they were in the process of isolating from the soil organism *Actinomyces lavendulae*. They termed this substance "streptothricin." It possessed considerable activity against gram-negative organisms but, when administered subcutaneously or intravenously to laboratory animals, frequently resulted in their death.

In January, 1945, the isolation of another substance, "streptomycin," from the soil organism *Actinomyces griseus* was announced by Schatz, Bugie and Waksman.[178] This new material was much less toxic than streptothricin and also appeared to be effective against gram-negative organisms. This substance now has had clinical trials and will be discussed at greater length later.

It is quite obvious that the surface of the field of antibiotics has only been slightly furrowed and the tremendous possibilities which are existent underneath are yet to be exploited. Even so, many facts are now known concerning the use of the newer members and it will be our purpose to set forth a few of them which have proved their worth in the postoperative care of patients undergoing operations for malignancy of the lower colon and rectum.

Penicillin. Following the isolation of this antibiotic by the British workers, its clinical application was carried forward rather rapidly in the United States as well as in England. It is known to be extremely effective against a number of pathogenic organisms, such as the pneumococcus; streptococcus; staphylococcus; the clostridia; certain gram-negative organisms, notably the gonococcus and meningococcus; and certain of the spirochetes including *Treponema pallidum*. Another advantage of this substance is its relatively low toxicity, while its chief disadvantage is in its instability, this necessitating parenteral administration of freshly prepared aqueous solutions. At the present time, oral administration is much too expensive for the aver-

retention of sodium ions and to increase the output of urine. In patients unable to assimilate sodium bicarbonate orally, it may be given intravenously. When we desire to increase the caloric intake, one-sixth molar racemic sodium lactate is used for the same purpose.

Sulfadiazine acts more efficaciously when the blood level is maintained at a concentration of 10 mg. per cent, and this level should be attained as soon as possible[192] with the dosage based on 0.10 Gm. of the drug per Kg. Thereafter, 1 Gm. is given every four hours. Frequently the drug is administered parenterally and, in such cases, it has been our policy to use 5.0 Gm. of the sodium salt daily in divided dosage of 2.5 Gm. every 12 hours, dissolved in 40 cc. of water. According to Henderson, the maintenance dose should be calculated on the basis of 0.05 Gm. per Kg., to be administered intravenously every 12 hours. Frequent determinations of blood levels should be made, and 20 mg. per cent should not be exceeded. In all cases, the oral route of administration should be employed as soon as possible. In severe infections, the initial parenteral dose of sodium sulfadiazine is based on 0.06 Gm. per Kg. and is followed by oral administration based on 0.15 Gm. per Kg. per day. The total amount is divided into six doses and given every four hours until the temperature has subsided. The dose is then gradually reduced until the patient becomes ambulatory. When used for acute or spreading peritonitis, maximum blood levels should be maintained parenterally. The sulfonamides should be supplemented with the various antibiotics, depending on the type of organism causing the infection.

Sulfamerazine. This drug resembles sulfadiazine very closely in its uses and mode of action, except that comparable blood concentrations are obtained with approximately one half the amount required when sulfadiazine is used.[199] It is absorbed more rapidly and excreted more slowly; for this reason, it is necessary to administer it less frequently than sulfadiazine.

Toxicity of the drug is no greater than sulfadiazine, and renal complications are less likely to occur following its use. In the absence of urinary complications, no great advantage seems to be gained by the administration of sodium bicarbonate, since the conjugated form of sulfamerazine is relatively soluble in both neutral and acid urine, as Beyer and others have demonstrated. The administration of soda bicarbonate increases the renal clearance of all absorbable sulfonamides by interference with their reabsorption. This effect is more striking in the case of sulfamerazine than in that of sulfadiazine, so that alkalinization makes the maintenance of adequate blood levels of sulfamerazine somewhat difficult without significant decrease in the chances of urinary complications. The bacterial specificity of this drug is comparable to that of sulfadiazine.

Nonabsorbable Sulfonamides. The mode of action, bacterial specificity and efficacy of the newer nonabsorbable sulfonamides were discussed under *Preoperative Management of cancer of the colon and rectum*. Postoperatively, sulfathalidine administration is begun in suspension form as soon as the patient is able to tolerate it by mouth (usually on the second or third day). The coliform organisms are consequently maintained at a low level. The result is less gaseous distention, nausea and vomiting, and, in the event of a leak at the suture line, there is less likelihood of severe peritonitis ensuing. It has been our experience that sulfathalidine has been very effective in lowering the coliform count, is nontoxic and also is beneficial in urinary infections.[14] It is our opinion that the incidence of the latter has been markedly decreased, as evidenced in our series of cases since sulfasuxidine and sulfathalidine have been used.[17] As previously reported,[13] we have been particularly impressed with the results achieved, inasmuch as several instances of

toneal cavity and into the bile, as well as other body fluids. It is excreted rather rapidly by the kidneys and, following a single injection, from 60 to 80 per cent of the substance appears in the urine within a 24-hour period.

Results of treatment reveal that streptomycin should be of definite value in the treatment of urinary tract infections, particularly where a single organism is the culpable agent of infection. In this group, due to the complex aspect of many of the cases, it is difficult to assess the relative merits of the drug. However, in gram-negative bacillary *infections it has given* definite promise. There seems to be little difference in the clinical response of *Escherichia coli, Proteus vulgaris, Aerobactor aerogenes* or *Pseudomonas aeruginosa.*

Results obtained in cases of bacteriemia due to gram-negative bacilli are also promising. It was the conclusion of Keefer[106] and others[151] that the results obtained in 53 cases of peritonitis were sufficiently encouraging for the drug to be used on all cases where the organism was susceptible.

Dosage. There are many practical as well as theoretical problems concerned with the proper dosage. The sensitivity of the organism, the type of infection present, its location, the size and the age of the patient, must all be considered.

The susceptibility of the organisms varies greatly, and for a more detailed guide to the range of susceptibility the reader is referred to Keefer *et al.*[106] These investigators advise testing the susceptibility of the organism and planning the dose accordingly. It should be noted that from 4 to 6 Gm. daily is the usual maximum tolerated dose, although as much as 10 Gm. daily have been given a few patients. These authors also referred to the work by Welch,[200] who demonstrated that in certain concentrations streptomycin increased, rather than decreased, the fatality rates in mice infected with *E. typhosa.*

In our patients, we have employed 2 Gm. of streptomycin in each 24-hour period. (2 Gm. in 12 cc. water; dosage, 2 cc. every four hours intramuscularly.)

Toxicity. Increasing clinical experience with the use of streptomycin has revealed that it is capable of producing a number of side reactions (an incidence of 20.5 per cent). It was also evident that the incidence of reactions was directly proportional to the increase in daily dosage. When this exceeded 1 Gm., a striking increase in the number of reactions occurred. Those most commonly encountered were cephalalgia, pyrexia, cutaneous exanthems, flushing of the skin and vertigo, either alone or in *various combinations.*

Acute toxicity and also the chronic type are mentioned. In the former group, frequency of painful, tender, indurated local reactions were noted, as well as the frequency of concurrent local inflammatory reactions. This was relieved to some extent by the use of procaine hydrochloride, 1 per cent solution administered with the streptomycin. Also, under acute toxicity, histamine-like effects of the substance were discussed, and the conclusion reached was that these were not of serious consequence although of frequent occurrence. Sensitization reactions were mentioned as being characterized by eruptions and fever. The eruptions were atypical but they did occur with greater frequency from the third to tenth days. They may occur following cessation of treatment, but some of them have persisted for as long as from seven to nine days.

Neurologic disturbances also occur with disturbing frequency, the most common being vertigo, with tinnitus and deafness additionally reported in several cases. Hinshaw reported that vertigo may possibly be a permanent impairment of function due to damage of the vestibular apparatus. He has additionally observed diplopia in some patients. Deafness was observed in several instances but was thought due to the disease and not the drug. Nevertheless, such reactions preclude using the drug indiscriminately or with impunity.

Bacitracin has been recently employed in

age case since it is necessary to use five or six times as much of the drug in this manner compared to parenteral administration in order to maintain adequate blood levels. High unitage beeswax in oil and vegetable oil mixtures are now being employed with considerable success.

The drug may be used orally, topically or parenterally. In operative procedures for sigmoid and rectal malignancies, its chief use is via the parenteral route; the optimum dosage is still a matter for controversy. Henderson advocated the minimal daily dosage of 100,000 units. Keefer[105] stated that Chase had done some work which led him to believe that massive doses of penicillin are partially wasted. He advocated 15,000 units every two hours in staphylococcic infections and 25,000 units every three hours for the streptococcic type. The practical work done by Crile[54] on peritonitis and abscess formation indicated that larger doses are of definite value in some types of infection. For routine postoperative administration we employ 100,000 units every six hours. Beyer and others have reported the use of sodium para-aminohippurate for increasing the plasma concentration of penicillin, but we have had no experience with this substance. Keefer and others have published the following list of infections in which penicillin has proved to be effective.

(1) All staphylococcal infections with or without bacteriemia
(2) All cases of clostridial infections
(3) All hemolytic streptococcal infections with bacteriemia and all serious local infections
  (a) Cellulitis
  (b) Peritonitis
(4) All anaerobic streptococcic infections
(5) All pneumococcal infections, including sulfonamide-resistant pneumococcal pneumonia
  Henderson has added pneumococcal peritonitis to the list.

It is important in the use of penicillin to obtain cultures of the causative agents and to test their susceptibility to it.

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Mode of Administration. An excellent study of this substance has been carried out by numerous investigators under the direction of the National Research Council. There are three common routes of administration: (1) intramuscular, (2) subcutaneous and (3) topical, including intrathecal, intraperitoneal and intrapleural. For systemic treatment, the first route seems to be the method of choice. One cc. of a 1 per cent solution of procaine hydrochloride may be added to 4 cc. of solution to decrease the attendant pain at the site of injection. In our department, streptomycin, for the most part, has been employed intramuscularly; in some instances it has been given orally.

Distribution and Excretion. The drug is found to pass rather rapidly into the peri-

toneal cavity and into the bile, as well as other body fluids. It is excreted rather rapidly by the kidneys and, following a single injection, from 60 to 80 per cent of the substance appears in the urine within a 24-hour period.

Results of treatment reveal that streptomycin should be of definite value in the treatment of urinary tract infections, particularly where a single organism is the culpable agent of infection. In this group, due to the complex aspect of many of the cases, it is difficult to assess the relative merits of the drug. However, in gram-negative bacillary infections it has given definite promise. There seems to be little difference in the clinical response of *Escherichia coli*, *Proteus vulgaris*, *Aerobactor aerogenes* or *Pseudomonas aeruginosa*.

Results obtained in cases of bacteriemia due to gram-negative bacilli are also promising. It was the conclusion of Keefer[105] and others[151] that the results obtained in 53 cases of peritonitis were sufficiently encouraging for the drug to be used on all cases where the organism was susceptible.

Dosage. There are many practical as well as theoretical problems concerned with the proper dosage. The sensitivity of the organism, the type of infection present, its location, the size and the age of the patient, must all be considered.

The susceptibility of the organisms varies greatly, and for a more detailed guide to the range of susceptibility the reader is referred to Keefer *et al.*[106] These investigators advise testing the susceptibility of the organism and planning the dose accordingly. It should be noted that from 4 to 6 Gm. daily is the usual maximum tolerated dose, although as much as 10 Gm. daily have been given a few patients. These authors also referred to the work by Welch,[200] who demonstrated that in certain concentrations streptomycin increased, rather than decreased, the fatality rates in mice infected with *E. typhosa*.

In our patients, we have employed 2 Gm. of streptomycin in each 24-hour period. (2 Gm. in 12 cc. water; dosage, 2 cc. every four hours intramuscularly.)

Toxicity. Increasing clinical experience with the use of streptomycin has revealed that it is capable of producing a number of side reactions (an incidence of 20.5 per cent). It was also evident that the incidence of reactions was directly proportional to the increase in daily dosage. When this exceeded 1 Gm., a striking increase in the number of reactions occurred. Those most commonly encountered were cephalalgia, pyrexia, cutaneous exanthems, flushing of the skin and vertigo, either alone or in various combinations.

Acute toxicity and also the chronic type are mentioned. In the former group, frequency of painful, tender, indurated local reactions were noted, as well as the frequency of concurrent local inflammatory reactions. This was relieved to some extent by the use of procaine hydrochloride, 1 per cent solution administered with the streptomycin. Also, under acute toxicity, histamine-like effects of the substance were discussed, and the conclusion reached was that these were not of serious consequence although of frequent occurrence. Sensitization reactions were mentioned as being characterized by eruptions and fever. The eruptions were atypical but they did occur with greater frequency from the third to tenth days. They may occur following cessation of treatment, but some of them have persisted for as long as from seven to nine days.

Neurologic disturbances also occur with disturbing frequency, the most common being vertigo, with tinnitus and deafness additionally reported in several cases. Hinshaw reported that vertigo may possibly be a permanent impairment of function due to damage of the vestibular apparatus. He has additionally observed diplopia in some patients. Deafness was observed in several instances but was thought due to the disease and not the drug. Nevertheless, such reactions preclude using the drug indiscriminately or with impunity.

Bacitracin has been recently employed in

age case since it is necessary to use five or six times as much of the drug in this manner compared to parenteral administration in order to maintain adequate blood levels. High unitage beeswax in oil and vegetable oil mixtures are now being employed with considerable success.

The drug may be used orally, topically or parenterally. In operative procedures for sigmoid and rectal malignancies, its chief use is via the parenteral route; the optimum dosage is still a matter for controversy. Henderson advocated the minimal daily dosage of 100,000 units. Keefer[105] stated that Chase had done some work which led him to believe that massive doses of penicillin are partially wasted. He advocated 15,000 units every two hours in staphylococcic infections and 25,000 units every three hours for the streptococcic type. The practical work done by Crile[34] on peritonitis and abscess formation indicated that larger doses are of definite value in some types of infection. For routine postoperative administration we employ 100,000 units every six hours. Beyer and others have reported the use of sodium para-aminohippurate for increasing the plasma concentration of penicillin, but we have had no experience with this substance. Keefer and others have published the following list of infections in which penicillin has proved to be effective.

(1) All staphylococcal infections with or without bacteriemia
(2) All cases of clostridial infections
(3) All hemolytic streptococcal infections with bacteriemia and all serious local infections
 (a) Cellulitis
 (b) Peritonitis
(4) All anaerobic streptococcic infections
(5) All pneumococcal infections, including sulfonamide-resistant pneumococcal pneumonia
 Henderson has added pneumococcal peritonitis to the list.

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Levin tube, preferably size 16, is used; it might be advisable to recapitulate the technic for passing the tube, since many still experience difficulty in correctly using continuous suction.

Ideally, intubation with either the Miller-Abbott or Levin tube is accomplished by use of the fluoroscope. It has been the author's observation, however, as well as that of others, that in most patients gastric suction is as competent as the duodenal type. Consequently, unless gastric suction fails to relieve the distention, no attempt is made to intubate the duodenum. The patient is carefully instructed, prior to passage of the tube, to swallow, if possible, without gagging, to breathe rapidly with the mouth open once the tube is inserted into the esophagus or when the urge to gag presents itself. The tip and adjacent length from 10 to 12 cm. of a well chilled, lead-tipped Levin tube is then inserted into the most patent naris as far as the nasopharynx. The patient is instructed to swallow some water through a drinking tube, and simultaneously passage of the tube is firmly started. Once the tube is in the esophagus, the patient is instructed to relax and breathe through the mouth. After a pause, the tube is slowly passed downward into the stomach with the aid of small sips of water. Difficulty is sometimes experienced at the cardia of the stomach and sometimes it is necessary to permit the tube to remain there for a few minutes prior to passing it into the stomach. Once the tube has reached that organ, it is advanced slowly, with the patient on the right side, until the tip is near the duodenum. Ordinarily the tube is left in this position. However, if it is desired to pass the tube into the duodenum, the patient is turned on the right side after the tube has entered the stomach. Suction is then applied until the stomach is empty and then it is discontinued and the tube slowly advanced to the region of the pylorus (2 or 3 cm. every 5 minutes). At this point, the fluoroscope is the quickest and most simple aid to accurate passage of either the Levin or Miller-Abbott tube. Once the tube is in the pyloric region, then a glass of water is given and, if necessary, an ampule of amyl nitrite is used to relax the pylorus. Should use of the fluoroscope be impractical, flat films of the abdomen may be taken to determine position of the tube. One is usually able to determine the position either by aspiration or injection of small quantities of air while listening with the stethoscope. Aspiration of almost pure bile assures one usually that the tube is in the duodenum.

Passage of the Miller-Abbott tube differs somewhat from the above procedure. The tube is passed into the esophagus in a similar manner, although in sensitive patients it may be expedient to use a cocaine spray. Once the tube is in the esophagus, 2 or 3 cc. of mercury are injected into the balloon, which has been previously checked for capacity and the presence of leaks. Passage of the tube to the region of the abdomen is the same as that for the Levin tube. These tubes are marked in centimeters and, depending on the size of the individual, when a point from 55 to 65 cm. is reached, the weighted balloon is permitted to remain at this location with the patient on the right side. A glass of water or amyl nitrite is used in the manner stated above. If more rapid and accurate passage of the balloon is desired, the fluoroscope is employed. Where the latter is not available, aspiration of the duodenal contents and distention of the balloon serve to locate the latter. Once it is in the duodenum, from 20 to 25 cc. of air are injected into the balloon to facilitate passage into the lower reaches of the small bowel. Care must be taken not to inflate the balloon too much, since damage to the small bowel, with obstruction as well as localized gangrene, has been produced from such a maneuver. Once the balloon has reached the desired point, it should be deflated. It might also be mentioned that careless removal of an inflated balloon has caused intussusception in the small bowel.

Harris[215] in a recent presentation before the Honolulu Surgical Society cautioned

a small group of cases, but no conclusions can be drawn. According to Poth,[214] 50,000 units orally each day in four divided doses showed no effect on the coliform organisms.

Postoperative Suction

It may be said without equivocation that no other measure has contributed so much to the preoperative and postoperative care of patients undergoing abdominal surgery with its preceding and ensuing complications as the use of gastroduodenal and intestinal suction. This principle has probably been of more importance than any other single factor in reducing mortalities following surgery of the large bowel. Any discussion of postoperative care would be incomplete without some mention being made of this subject.

Nearly everyone is familiar with the excellent treatise written by Wangensteen,[31] in which the author described his observations of ileostomies and jejunostomies in obstructions which led to the use of duodenal suction in these cases in preference to operative procedures. As an end result of these observations, the Levin tube with continuous suction and the various modifications of it, including the Miller-Abbott tube, came to be routine treatment. Since the initiation of continuous suction, a review of the physiology of the intestinal tract has revealed the simple secrets of its success. Gas and fluid are normally present in the bowel, and when obstruction exists, large accumulations of both are usually present. Normally, large amounts of fluid are secreted in the stomach and small bowel; large amounts of air are swallowed, gases arise from digestive processes within the bowel and also from the blood stream. In the presence of obstruction these elements accumulate with resultant distention. Removal of these contents, as well as removing the air ingested, accounts for the success of continuous suction. Wangensteen demonstrated rather definitely that swallowed air is the most important factor contributing to gaseous distention of the bowel. In the success of this important measure also lies its most important complication, i e., loss of fluids and electrolytes which needs must be replaced in order that normal body metabolism be maintained. (This was discussed in detail in the section on fluid balance.)

Indications for the Use of Suction. Originally, suction was employed in cases of obstruction, as mentioned heretofore under Preoperative Management. Since its value was so well demonstrated and it was found that part of its success was due to removal of the swallowed air, continuous suction is employed routinely for all resections. It is the author's opinion that this procedure should be employed postoperatively in all cases where ileus occurs, either the paralytic or mechanical type. In our department it is customary for suction to be used routinely following operation until evidence of returning bowel motility appears in the form of audible peristalsis or passage of flatus from the bowel. This applies to all of our patients upon whom laparotomy has been performed. Ordinarily, suction is discontinued at the end of 36 hours. For the average patient undergoing abdominoperineal resection, the ordinary lead-tipped Levin tube for gastroduodenal suction is adequate. However, in cases of peritonitis with generalized ileus, and in patients with mechanical obstruction due to localized peritonitis with edema and fibrous adhesions, the Miller-Abbott tube is employed with a greater degree of success. Occasionally, following abdominoperineal resection, there occurs a moderate degree of persistent distention for from four to five days. In these patients the Miller-Abbott tube has proved useful where gastroduodenal suction has not sufficed. Suction is employed in many other instances with gratifying results, but those with malignancies of the left colon and rectum are the ones with which we are chiefly concerned.

Technic of Suction. The technic employed on our service is similar to the one described by Wangensteen. For routine gastric or duodenal suction, a lead-tipped

thereby is maintained at a constant level.

It is essential to collect and measure the fluid that is withdrawn by the Wangensteen suction for each 24-hour period in order to plan a correct administration of fluids. This phase has been discussed in the section on fluid balance.

Vitamin Therapy

The relatively recent advent of vitamin therapy has resulted in a practice which is, as a general rule, unwise medically from a logical therapeutic standpoint. This has been the indiscriminate use of vitamins in large doses without any actual clinical basis for such dosage. Not only is this a financial burden for the patient but it may also result in complications, as well as an actual waste of the vitamins.[216] Numerous articles are available in this respect.

Consequently, we have made an attempt to administer vitamins in dosages which are based on minimal daily requirements as recommended by various investigators and on a clinical evaluation of generalized avitaminosis.

As has been stated previously, a number of investigators have called attention to the existence of avitaminosis in patients with gastro-intestinal malignancy. It is to be remembered that there is an acute period of starvation postoperatively during which the patient receives no vitamins except those administered parenterally. In an attempt to approach ideal nutrition, both of these factors should be kept in mind. Regardless of the fact that the literature is cluttered with publications on vitamin deficiencies and their recognition, etc., there is very little definite clinical investigation upon which correct vitamin dosage can be based. Some excellent work has been done on the relation of vitamin C to wound healing, the most recent being that of Walfer.[194] Due to the fact that vitamin A, B, and C deficiencies exist quite frequently prior to operation, it seems wise to use the vitamins postoperatively as well as preoperatively; all are available for parenteral use, and it has been our practice to begin their administration on the first postoperative day. Bartlett[20] demonstrated the role that vitamin C plays in wound healing both experimentally and in human subjects. He believed that the plasma level of vitamin C must be below 0.2 mg. per cent before any appreciable effect on wound healing was observed. Despite a vitamin C deficiency at the time of operation, adequate healing may be obtained by the use of adequate vitamin C therapy postoperatively. Kraybill[115] believed that it was not unusual for ward patients to possess negative ascorbic acid blood levels and he was of the opinion that this test is not too reliable. Following daily doses of 150 mg. of vitamin C, he was unable to detect any ascorbic acid in the plasma for from four to six weeks. He believed, therefore, that this was an inadequate dose. Buford found that 600 mg. per day were necessary to obtain detectable plasma ascorbic acid. Lund[120] recommended 1 Gm. of the vitamin daily for five days and then 100 mg. thereafter. Walfer and his co-workers definitely demonstrated that there is a diminution in the tensile strength of wounds prior to the use of vitamin C in scorbutics. Complications were frequent, and the authors administered 1,000 mg. doses in these cases until the plasma level reached 1 mg. Postoperatively we administer 1,000 mg. daily for from 5 to 6 days, and then 500 mg. orally. In a personal communication, he recommends the use of vitamin C blood levels to determine the optimum dosage. Our biochemist, Doctor Hamilton, believes that this determination is not too valuable, so we have accepted Walfer's regime and use from 500 to 1,000 mg. daily, both preoperatively and postoperatively.

The deficiency of vitamin B components is well recognized and it may also be stated that any such deficiency cannot be remedied in the usual postoperative period. For this reason, we routinely inject from 2 to 4 cc. of vitamin B-complex (Betalin) intramuscularly daily for four days in the average

against the use of more than three feet of tubing below the pylorus. He further advised that the rubber tube tip prior to insertion be flushed with CO_2 in order to prevent dilatation.

bate the stomach while a Miller-Abbott tube is also being used. Wangensteen has mentioned the difficulty arising from intubation of the duodenum and suggested the use of piano wire as a stilet.

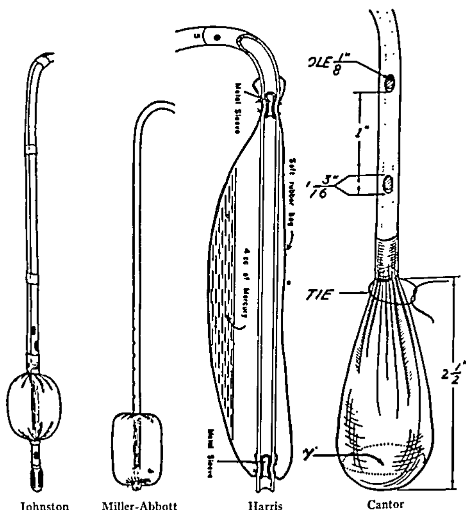


Fig. 727. The "head" of each of the four intestinal decompression tubes in use today. This head constitutes the propulsive mechanism. In only one head is there a radical departure from previous types. Note the complete absence of all metal parts in this tube head. (Cantor: Am. J. Surg. 73:442, 1947.)

For successful suction, competent nursing care is essential. Small frequent sips of water are necessary for adequate suction. The tubes must be watched for blockage and irrigated or manipulated to insure patency. When the Miller-Abbott tube is used, one must be careful that the stomach does not become distended after the tube has passed into the small bowel. In some instances we have found it necessary to intu-

The usual problems, such as correct amount of suction necessary and the use of a third bottle to collect the drainage, have been eliminated in our hospital by the use of a commercially made suction. This is mounted on a steel stand so that the bottles may be inverted to reverse the flow of water. The correct height of the column of fluid which governs the amount of suction (two feet six inches)

as fall in blood pressure following onset of pain resulting from inception of spinal anesthesia, etc.; (2) vasogenic, such as that resulting from histamine, anaphylaxis, etc.; and (3) hematogenic, such as an actual decrease in blood volume. It is the consensus of belief that shock arising from trauma may be either hematogenic or vasogenic, due chiefly to diminution of the effective circulating blood-volume. This theory has been well supported by the experiments of Stewart and Warner,[184] Emerson and Ebert[65] and others, in connection with blood and plasma volume in the wounded.

There is another factor which has been recognized by numerous investigators, that classified as clinical evidence of hematogenic shock. This does not develop immediately but is preceded by protracted periods of circulatory change. It is evident, then, that efforts should be employed to direct attention to the earlier signs and symptoms present, so that prevention rather than treatment may be the method of procedure.

Equally important is the essential need of the surgeon to anticipate operative trauma and hemorrhage, so that prompt administration of either blood or plasma may be effected. This would insure maintenance of adequate and normal circulating blood volume, which of itself would definitely inhibit the onset of this troublesome sequela.

Incipient Phases. In surgery of the lower bowel and rectum, recognition of the early phase of shock, while always to be looked for, does not possess the importance which may be attached to it if it occurs under different circumstances. As a rule, measures have been taken to anticipate its complicating the situation. However, there have been instances where massive hemorrhage has occurred or delayed shock takes place following the patient's return to bed. In this connection, some observations which have proved timely and valuable are discussed.

The appearance of the patient probably possesses greater value in detecting impending shock than all of the laboratory procedures put together. The presence of profound pallor, apathy, an apprehensive state, cold, clammy extremities, all point to the characteristic picture. The pulse is invariably rapid and thready, although this phase may be misleading, as not infrequently a relative bradycardia present in patients who shortly afterward went into profound shock has been evidenced. Blood pressure is equally unreliable, as an appreciable drop does not occur until profound shock has become well advanced. Mahoney and Howland made mention of this low pulse pressure concomitant with profound shock, but this is not a constant finding.

Hematocrit determinations in series are valuable in determining the degree of shock as well as a guide to therapy, even though a relatively simple procedure, in the presence of a delayed reading, may be useless, as shock is likely to intervene.

Drew[60] indicated four tests which he deemed worthy of mention: (1) determination of cell percentages in venous blood by hematocrit reading; (2) determining the specific gravity of whole blood; (3) specific gravity of the plasma, and (4) plasma protein determination by simple formula. The author calls attention to the speed with which these procedures may be done, their accuracy and the limited amount of equipment necessary for their performance. It is, however, quite essential that all four be correlated prior to interpreting the condition of the patient, which, in the presence of both traumatic and hemorrhagic shock, is somewhat difficult to do. Usually, maintenance of high plasma levels and blood specific gravity, with a concomitant falling hematocrit reading, is evidence of hemorrhage. So many factors enter into the determination of these values that they must be considered in the light of their value as a whole and not as isolated integers.

Prophylaxis and Treatment. The proverbial "ounce of prevention" is obviously the best form of treatment. The majority

case. Although there is no definite evidence that this vitamin influences wound healing, we believe that it plays an important role in this process.

It has also been our observation that vitamin B-complex apparently increases muscular tonus and returns peristalsis earlier. Older individuals seem to derive a "boost" from the administration of B-complex. After patients have begun to tolerate food, multivitamin capsules which contain slightly more than the daily minimal requirement are administered three times a day. It is impossible postoperatively to administer all vitamins parenterally during the period of acute starvation. However, it is possible to furnish those which assume the most importance in terms of nutritional requirements.

Complications and Sequelae

Shock. Recognition and treatment of this ever present possibility are both subjects of pertinent significance and relevancy in the care of the patient during and following completion of the operative procedure. To omit a discussion of this syndrome would result in an incomplete delineation of a most important phase in postoperative care. In no other field of adjunctive treatment have greater advances been made than in the treatment of shock.

The late world conflict with its stimulation of the production and administration of blood plasma and well regulated scientific control of blood banks has served, at least, one good purpose—that of the saving of countless lives by affording a method for the prompt prevention and treatment of shock.

In this section it has been the author's chief concern to deal with shock in terms of trauma and hemorrhage. Quite obviously it is a definite impossibility to include the multiplicity of theories relevant to these factors, as no single cause can be deemed culpable. Both of them are connecting threads and, while they may be regarded as separate entities, when taken together they carry impressively potential weight.

As previously stated, Blalock,[38, 37, 36] believes that a combination of factors work together to make the complete picture, considering it a "peripheral circulatory failure resulting from a discrepancy in size of the vascular bed and the volume of intravascular fluid." In connection with the latter phase, several theories have been advanced about the causative agent responsible for this fluid loss: (1) actual loss of both blood and plasma at the site of trauma, externally as well as into surrounding tissues; (2) toxemia, with a resultant increase in capillary permeability and (3) vasoconstriction, with a fourth occurrence of no inceptive impulses.

There seems to be considerable controversy about the mechanics of shock as a distinct entity, and in this connection several physiologic reactions are more or less agreed upon. Peripheral vasoconstriction, with concomitant diminished peripheral blood flow, has been demonstrated by Freeman[70] and discussed by Mahoney.[131] Both venous and arterial blood pressures fall, with a diminished cardiac output, and oxygen saturation of the blood is decreased (anoxemia); there is also a concomitant diminished consumption in the tissues. Large quantities of plasma protein are lost, resulting in increased concentration of the blood. Plasma potassium increases, tissue anoxia, together with a generalized capillary permeability, may also be evidenced. The successful use of adrenal cortex has indicated that adrenal glandular failure plays an important part in the maintenance of reserves which act as inhibitors of the syndrome.

As a result of an attempt to classify shock into primary and secondary phases, needless confusion has arisen. As a matter of fact, both phases are probably the outcome of the same causative factors Mahoney has suggested a classification which would seem to more clearly delineate the various types of the syndrome. In substance it is as follows: (1) neuro such

of 800 patients with malignancy of the lower bowel, there were 33 deaths following 638 resections, a mortality rate of 5.1 per cent. By the accompanying chart it will be noted that peritonitis was the cause in 13 patients, an incidence of 39.3 per cent.

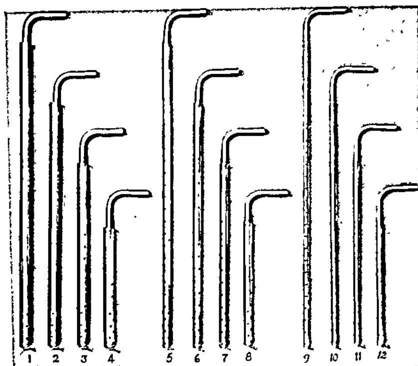


Fig. 728. Babcock alloy steel drains of various lengths and dimensions

Cause of Death in 638 Resections for Cancer

Peritonitis	13 (39.3%)
Pulmonary embolism	5
Myocardial failure	4
Uremia	3
Cerebral thrombosis	2
Obstruction and pneumonia	1
Obstruction	1
Shock	1
Diabetic coma	1
Hemolytic transfusion	1
Anesthesia (autopsy)	1
	33

The above comments and the results shown should in no way be construed as detrimental to the value and efficacy of these adjuncts, namely, preparation and after-care, including sulfonamides and antibiotics. This incidence of peritonitis is inclusive over a period of several years, and while use of sulfonamides were begun in 1942, penicillin was not employed until 1946, and streptomycin in 1947. It may be mentioned that from the middle of January, 1946, to May, 1947, 145 consecutive resections of the rectum and sigmoid were performed by the author without a single death.

In all fairness it must be admitted that extended procedures and very formidable maneuvers are being performed today with but little increase in the mortality rate (see Malignancy, Chap. 19, p. 751). There have been innumerable instances in our present regime of therapy where contamination has occurred during operation as a result of perforation of a brittle, infiltrated bowel incident to handling and liberation: where

of our surgical procedures are performed during the afternoon hours; prior to each individual operation, painstaking effort has been put forth to establish fluid balance and to correct any anemia and hypoproteinemia with appropriate treatment. During the morning hours of the day surgery is to be done, various procedures deemed essential and of proven value have been applied to the patient. During the procedure of abdominoperineal resection, between 500 and 1,000 cc. of blood are administered, depending on the condition of the patient and blood loss during the operation. The blood flow is governed so that it enters slowly, leaving between 150 and 250 cc. to run in, following the patient's return to the room. It has been found that this procedure is an ideal preventive of a drop in blood pressure due, in most instances, to inevitable changes in position following extensive surgery. Should this condition be at all questionable, an erythrocyte count together with hemaglobin, hematocrit readings and protein determinations are immediately performed and, where impending shock is evident, with a tendency to a drop in blood pressure reading, an additional 500 cc. of whole blood are given, using the same procedure of administration mentioned above.

Meticulous observation of this routine will do much to prevent shock, unless, which is always possible, an unligated vessel or a slipped ligature results in hemorrhage. The performance of blood pressure readings every half hour with erythrocyte, hemoglobin, hematocrit and serum protein determinations will readily distinguish between shock resulting from peripheral circulatory failure and that due to hemorrhage.

Shock is a rare occurrence twelve hours following surgery unless secondary hemorrhage ensues. Provided the fluid, electrolyte and nitrogen balances are kept static, such incidences are exceptions and not the rule. The administration of plasma is a valuable adjunct in treating shock, but the type of cases on our service require it only to maintain blood volume until whole blood is available.

During the late war, military surgeons, among them Churchill, Stewart and Warner, as well as Emerson and Ebert, recognized the value of this form of treatment of severely wounded personnel, crediting it with saving very many lives by enabling them to transport these severely wounded men to rear echelons where further surgical procedures could be done which would not have been possible had shock intervened. In numerous cases, particularly in geriatric surgery, we have used suprarenal cortical extract (Eschatin) in large doses, as recommended by Drew[60] and also Koster and Kasman.[113]

An additional postoperative procedure is the maintenance of the Trendelenburg position for 12 hours following the operation. unless contraindicated. The maintenance of body heat is preserved by the use of light blankets, although Blalock does not approve of this procedure, since his observations led him to believe that excessive external heat may be harmful.

Due to the presence of anoxemia and concurrent tissue anoxia, invariably present in shock with the additional decrease in the *peripheral circulation*, oxygen in 100 per cent concentration should be administered for a 12-hour interval postoperatively until the imminence of shock is no longer apparent. Cytochrome C also holds promise in regard to the same problem.

Peritonitis. Until a few years ago, the death toll following resection of the colon and rectum was high, chiefly due to peritonitis. With the institution of rigid preoperative preparation and postoperative care which included sulfonamide, penicillin and streptomycin therapy, we became almost convinced that peritonitis following operation represented a complication of the past. While it is true that peritonitis today is of infrequent occurrence, a perusal of any large group of cases is sufficient evidence that this major complication is still the chief factor in mortality. In our own series

occur during operation, a Babcock metal sump drain is placed in the pelvis, provided, of course, the pelvic floor has been re-established, such as in the Miles operation or where a low anastomosis has been performed. With contamination coincident to resection of the colon, where the pelvic diaphragm is in no way affected, sump drainage is also employed.

Where free dependent drainage is not used, we introduce through the abdominal wound or a separate suprapubic stab one or more perforated tubular drains of rustless steel, 8 mm. in diameter, with an inner continuously acting suction tube. Beginning with nearly pure blood, the material removed gradually becomes more serous and finally, after two days, will cease to drain, when it is removed. Differing from rubber and plastic drains, which provoke encasing adhesions, this type drains the general peritoneal cavity for two or more days and gives early evidence of hemorrhage, of leakage or of the onset or subsidence of an ileus. According to Babcock,[11] ileus is characterized by a sudden great increase in the amount of serum aspirated from the peritoneum. In several cases in which fecal leakage has occurred after anastomosis, these drains have prevented diffusion in the cavity and led to the formation of a narrow fistulous tract which has closed spontaneously.

More recently, where contamination has occurred, 500,000 units of penicillin and 2 Gm. of streptomycin have been placed in the abdomen, in which event suction to the sump drain is not instituted for the first 12 hours.

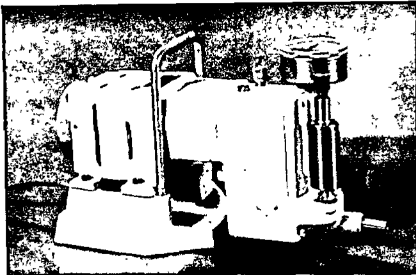


FIG. 729. Babcock-Stedman pump.

Constant Wangensteen suction, which is begun immediately prior to operation, is continued until auscultation reveals the return of normal peristalsis or flatus is expelled by bowel. The purpose here is, of course, to aspirate gas, swallowed air and intestinal contents, thereby effectively treating the reverse peristalsis, distention and vomiting. Oxygen likewise is administered routinely during operation and continued for from 12 to 24 hours in high concentration 93% oxygen and 7% carbon dioxide by means of the B.L.B. mask. Oxygen is helpful in relieving intestinal distention and in correcting anoxemia.

As to sulfonamide therapy following operation, we have omitted use of the absorbable drugs during the past two years, unless contamination is encountered. If such

extirpation of the gut has included removal of the uterus and vagina and resection of a portion of the bladder, ureter and small intestine; during the performance of an open anastomosis or slipping of the clamp in the closed method; and where the bowel has been purposely opened for the removal of an adenomatous polyp, with but little effect on the mortality and morbidity. Peritonitis may follow contamination. While it may occur from leakage at the suture line due to improper technic, it more often results from necrosis caused by inadequate blood supply to the segments anastomosed or the portion of bowel pulled down, as in proctosigmoidectomy.

Symptoms and Diagnosis. Quite frequently the classical signs and symptoms are so slight during the postoperative course that they may readily escape recognition. In such, the rise in temperature and abdominal tenderness and distention are no more than is found following a radical procedure. On the other hand, the onset may be sudden with elevated temperature and pulse, abdominal rigidity and marked prostration. The character of the pain, its onset, location and intensity may yield valuable information.

Since the symptoms are so indefinite, physical examination is of utmost value. A doughy feel to the abdominal wall may be elicited, for in many instances rigidity is absent. Sweet recommends a procedure which we have found of value following resection of the sigmoid and rectum; if examination is begun in both flanks posteriorly at the same time and brought forward, definite tenderness and rigidity may be felt in the peritoneal gutters. The peristaltic sounds in peritonitis are usually faint, of short duration, infrequent or absent, depending on the extent and stage of the process, whereas in obstruction they are usually frequent, loud and exhibit variability in quality. In late stages of obstruction, the peristalsis is less active and the sounds assume a tinkling quality. These are points well to remember because the differentiation between ileus of peritonitis and mechanical obstruction is usually difficult. Elevated temperature, increased pulse rate, leukocytosis, accelerated respirations and vomiting are additional signs.

Treatment. *Preventive and Active.* As discussed elsewhere in this chapter, all patients are given nonabsorbable sulfonamides before and following resection. The coliform count is therefore lowered to a level of 1,250 organisms per gram of wet stool and attempts are made to maintain it at that level. Streptomycin is routinely employed for 48 hours prior to operation and penicillin in all cases following operation. Zintel *et al.*[210] have recently reported their investigations with combined therapy in dogs, while Rowe and the author have cited their experience with combined therapy in surgical patients.[10] Where sensitivity tests reveal a "resistance" or a "reversal," further administration of the penicillin or streptomycin, whichever the case may be, is discontinued. By diet and methods already outlined, the bowel at the time of operation is usually clean and tranquil. The principles outlined by Halstead should be always respected, namely, minimal tissue trauma, aseptic technic, careful hemostasis, the use of fine, nonirritating suture material and the avoidance of mass ligature. Careful attention to the blood supply and avoidance of tension upon the suture line are more important than the type of clamp or even the suture material. In abdominoperineal resections and especially proctosigmoidectomy, preservation of the arterial pattern is of primary importance. In this procedure, where no complete pelvic diaphragm is formed, drainage in our cases is established from below (see p. 743).

Until two years ago, sulfanilamide and later sulfathiazole powder (5 Gm.) was widely sprinkled over the viscera in all cases before closing the abdomen. Then, because of jaundice which occurred in five patients, it was reduced to 2½ Gm., which amount we still employ with no apparent untoward reaction. Should contamination

gradient ileus,[9] is defined by Giuz[81] as "a disorganization and impairment of motor function of the intestine, sometimes resulting in complete cessation of motor activity with consequent functional obstruction." This lack of propulsion of the intestinal contents is due not to paralysis of the musculature, for which reason "paralytic ileus" is a misnomer, but to stimulation of the sympathetic nervous system.

Adynamic, or inhibition, ileus is not an infrequent complication and one for which the surgeon and resident staff must be always on the alert. It develops progressively from the immediate postoperative period, usually between the fourth and seventh day. Tympanitic distention, absence of pain except possibly at the site of the incision, vomiting, persistent, recurrent and absence of peristalsis on auscultation of the abdomen, are symptoms and signs commonly encountered. Ordinarily the temperature is not elevated or is only slightly so. Evidence of hypochloremia becomes apparent from loss of fluid containing electrolyte. (The origin of the intestinal gases and the results from fluid and electrolyte loss have been discussed under Fluid and Electrolyte Balance.) A flat plate of the abdomen is frequently a helpful adjunct. In adynamic or inhibition ileus the distention of the bowel is segmental, whereas in mechanical obstruction the distention is above the point of obstruction The film of the patient in the supine position discloses distention without the sharp contrasting lines. Free movement of gas is noted with change of position of the patient. With inhibition ileus as a result of peritonitis, a few dilated loops adjacent to the site of peritonitis may be seen in its incipiency, whereas when the infection becomes well established, accumulation of fluid, as indicated on the film by the increase in the shadow between the loops of bowel, may be noted.

Following resections on the rectum and colon, inhibition ileus may occur. Where peristalsis fails to return, peritonitis should be suspected. If this complication does occur and is permitted to pass untreated, the typical picture of increasing distention, vomiting, dehydration, hypochloremia and shock, as discussed under Peritonitis, may supervene.



Fig. 731. R. J.: Intestinal obstruction occurring eight days following sigmoidectomy. Film of the abdomen in an upright position shows characteristic distention of loops of the small bowel and fluid levels. Tube shown in cecostomy.

Treatment. The best treatment is prophylaxis, which should be instituted prior to operation, and continued during the surgical procedure with especial attention to choice of anesthesia, trauma to tissue and blood loss. In all instances special consideration is given to nutrition, fluid and acid-base balance. The routine use of intubation drainage has proved of value. The hydrodynamics of this have been discussed. It has been our custom to discontinue suction only when peristalsis becomes audible, and even then it is better to instill small amounts of fluid with the tube clamped before the Levine or Miller-Abbott tube is withdrawn.

Since June, 1946, irrigation of the abdominal colostomy or perineal anus has

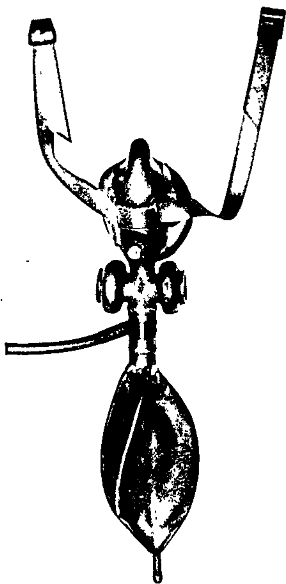


Fig. 730. B. L. B. mask.

occurs, sodium sulfathiazole is begun the following morning, or approximately 16 hours after operation. It is administered intravenously, 2½ Gm. twice daily. In our experience morphine is the drug *par excellence* and is used frequently and in therapeutic doses. As is our custom, the patient is placed in semi-Fowler's position the day following operation, and movements of the limbs are begun; semiflexion of the legs is avoided (see Thrombo-embolic Disease). In various types of resections on the colon and rectum, the semi-Fowler's position is ideal, by virtue of the dependent drainage afforded. In proctosigmoidectomy, where no complete pelvic floor is established, this position gives direct drainage to the presacral space, from which point the obligation is assumed by the curved metal, perforated drain (see p. 743). It may be mentioned that our concept regarding the peritonealization of all denuded areas has become somewhat altered because in a personal series of over 400 proctosigmoidectomies, with no attempt to reconstruct the peritoneum over these raw areas, no particular difficulty has been encountered, with the exception of four instances of pelvic abscess. Three were successfully drained through the abdomen; the fourth patient died undiagnosed. Autopsy disclosed retroperitoneal extension. In another instance quite unrelated to peritonealization, subdiaphragmatic abscess was diagnosed by roentgenogram but was unconfirmed by exploration.

In all cases, fluid and acid-base balances are restored and maintained as described on page 1017 of this chapter.

Obstruction. Intestinal obstruction is an inclusive term to denote hindrance to the forward movements of bowel contents. Following major surgical procedures on the rectum and colon, two types of obstruction are encountered, although a third—the physiologic may be mentioned.

A. Physiologic Ileus. Physiologic ileus occurs following any type of operation in which the abdomen is opened. A certain degree of temporary paresis of the intestinal tube takes place, the severity of which is directly proportional to the injury sustained by the viscera and peritoneum. According to Mason, the exact etiologic factors are unknown, but the most plausible theory is that trauma to the peritoneal nerve endings is the fundamental cause. This type of ileus usually is self-corrective or will respond to simple measures, although it may progress into inhibition ileus.

B. Inhibition Ileus. Inhibition ileus,[194] also termed adynamic, paralytic or flat-

the enema is of more import because, if gas is expelled, the occlusion is incomplete. Hendricks[100] states that if a patient can take 2,000 cc. of a tap water enema, the site of the obstruction is proximal to the hepatic flexure. Other symptoms are toxemia with rapid, feeble pulse and prostration, usually without elevated temperature or leukocytosis. Objective symptoms are distended abdomen, tympanites with later evidence of fluid in the peritoneal cavity, visible and audible peristalsis.

Diagnosis. Recurrent intestinal borborygmi at the acme of concurrent colicky pain, followed by distention in the early hours of obstruction, are of utmost importance as a diagnostic criterion. If scout films are diagnostic, loops of gas-filled distended bowel are shown. The erect film discloses fluid levels in the distended bowel; such signs may not be apparent in very early stages but usually will be in evidence by serial roentgen study. Large bowel obstruction often discloses distention, confined for the most part to the colon due to competent ileocolic valve and sphincter (61 per cent[105]). Therefore, participation of the small intestine in the distention is ordinarily uncommon. In the absence of inflammatory complications, the leukocyte count is normal or nearly so; estimation of the erythrocytes is normal or increased, depending on the degree of dehydration, for which reason the hematocrit and blood volumetric readings are of more value. The blood chlorides are reduced where vomiting is present, while the nonprotein nitrogen and carbon dioxide content of the blood are usually increased.

Treatment. It is generally accepted today that while intestinal obstruction demands emergency treatment, it does not necessarily require emergency operation. As Gatch[78] has well stated, "No reduction in the death rate from bowel obstruction was made until surgeons realized that it consists as much in the correction of bodily derangements caused by obstruction as in the obstruction

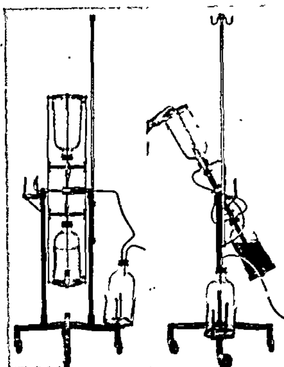


Fig. 733. Wangensteen suction apparatus.

itself." Immediate suction using the Miller-Abbott tube is instituted, as well as oxygen in high concentration. Fluids in the form of whole blood, plasma, saline and glucose with protein hydrolysate are administered parenterally. Where a colostomy has been made, a saline enema is given. If immediate continuity of the bowel has been established, a rubber tube is inserted into the rectum. Hourly examination of the abdomen with the stethoscope is indicated in these patients, and where proper response has not taken place (usually from 24 to 48 hours), such as relief of distention and passage of flatus, surgical decompression is instituted.

We do not hesitate to perform enterostomy or colostomy, whichever may be necessary. Inasmuch as these patients are usually sick, infiltration analgesia is a good choice. By the same token, it is not always wise to subject the individual to additional shock by attempting to locate the point of obstruction. Of course, whereas simple ob-

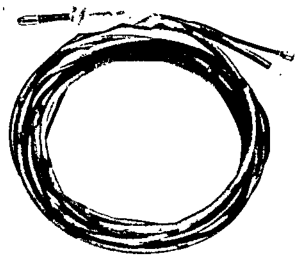


FIG. 732. Johnson intestinal tube.

been instituted in all patients following resection. A large, soft-rubber mushroom catheter held in place by a Daniel's clamp (see pp. 743 and 774) through which saline solution is instilled every four hours beginning the morning following operation, has appeared to diminish the incidence of ileus.

Oxygen in high concentration (see p. 998) is employed routinely for from 12 to 24 hours for purposes already discussed. Even though it has no effect upon retained liquid contents of the bowel, it should be continued or reinstituted where ileus is suspected. Hot applications to the abdomen will increase the intra-abdominal temperature and, according to Ochsner,[155] reduce the incidence of distention. Its effect on motility is open to question.[35, 44] At least some degree of comfort is afforded the patient.

Additional measures, such as splanchnic block or spinal anesthesia[158, 191] and intravenous hypertonic saline solution,[94, 142, 157, 174] have not proved uniformly effective aside from the important fact that their use may be hazardous.

Anticholinesterase drugs, of which prostigmine is the most widely used, may be employed with caution in small doses in the prevention and active treatment of postoperative ileus. Its indiscriminate use, however, is not without damage, because by inhibition of the cholinesterase and potentialization of the effects of acetylcholine[29] complete obstruction or perforation may be produced. Occasionally in our cases of resection with immediate end-to-end anastomosis, gentle irrigation of the proximal colostomy (transversostomy or appendicostomy) is begun immediately following operation and continued at four-hour intervals. (Now seldom employed.) Ordinarily saline or a 15 per cent solution of hydrogen peroxide was instilled, although, if distention continues unabated, glycerine, one-half ounce to three ounces of water, may be used. A dose of three ounces is recommended by Babcock. This, too, should be used with caution.

C. DYNAMIC, MECHANICAL, OR OCCLUSIVE, OBSTRUCTION. This occurs occasionally during the postoperative period usually after a lapse of several days. While a serious complication, it is not usually fatal unless unrecognized and unrelieved. The symptoms vary according to the onset, completeness of obstruction and degree of circulatory involvement. In general the subjective symptoms are (1) pain, mild to excruciating in type and paroxysmal; (2) abdominal distention; (3) vomiting, at first gastric, perhaps biliary, pancreatic and upper intestinal, which later may be black, acrid, foul-smelling fluid admixed with fecal material and (4) obstipation. In this last respect, one should be mindful that where the bowel is completely occluded, no feces can pass the point of obstruction, although patients may describe one or more evacuations. Such is accountable by the fact that immediately prior to complete obstruction, fecal material may pass the partially occluded site, and later, when the obstruction is complete, the distal fecal material may be expelled by rectum. Enemata are of value only in that they may empty the colon. Subsequent enemata are therefore returned as given. Absence of flatus with

right than in the left leg. Embolism rarely begins at the operative site, although it may begin from a thrombosis in a traumatized vein. According to McCartney,[136] who reviewed the literature rather extensively, the incidence of pulmonary embolism varies from 1 to 12 per cent. This occurrence is not necessarily limited to surgical patients. Hampton and Castleman[85] found that in 370 cases of pulmonary embolism, 60 per cent were medical patients. Others have pointed to the high incidence in cardiac disease and also in obese individuals. Hines and Hunt noted pulmonary infarction in 35 per cent of 234 necropsies of patients who died primarily from cardiac disease. McCartney points to several factors which leave these various statistics open to criticism.

In McCartney's series of 28,771 autopsy records, 4,070 were postoperative deaths, of which there were 471 instances, or 11.5 per cent, where thrombo-embolism was present and 5.3 per cent, or 216 cases, where pulmonary embolism was the cause of death. Operations on the large intestine took fifth place in his series in the list of possibilities for fatal embolism and seventh place in the number of fatal embolisms actually produced. Thus large intestinal operations had fatal embolism in 5.4 per cent of the cases, and none of these occurred before the fifth decade of life.

Barker and his associates[24] found that venous thrombosis and pulmonary embolism are relatively twice as common following laparotomy as they are following all other operations, and they are three times as common following laparotomy in which operations on the female pelvic organs were done as they are following all other operations. The highest incidence of venous thrombosis and pulmonary embolism occurs in operations where there is laparotomy and extensive resection of tissue. These are operations which can be considered to be of relatively long duration and of relatively great magnitude. Welsh and Taxon[201] have also stated that one out of every three patients with deep phlebitis may be expected to have pulmonary embolism.

Allen states that the staff at Massachusetts General Hospital has been confronted with a serious problem concerning venous thrombosis with resulting pulmonary embolism. He points to Castleman's work, which revealed that pulmonary embolism in 95 per cent of their cases resulted from thrombosis of the deep veins of the legs. He points to the data collected by Davis, which showed that three patients out of every 1,000 subjected to major surgery succumbed to pulmonary embolism. He also quotes the figures of Welsh and Taxon, which revealed that the incidence of fatal embolism was reduced to 1 in 800 with use of early ambulation, prevention of stasis by posture, and early exercises. He still feels that there is a terrific morbidity due to this complication in their clinic following the use of conservative measures. He stresses the importance of age incidence, pointing to 10,000 cases of wounded and sick soldiers in which there were only 7 cases of thrombophlebitis. Allen found that venous thrombosis was more common in certain clinics and in certain geographic locations. Everyone is agreed that the incidence is much higher in the older age group, in cardiac disease, in patients having had previous embolic phenomena or thrombophlebitis, and following pelvic operations. Other predisposing factors are obesity, debility, changes in the hematopoietic system, such as polycythemia and anemia, and excessive smoking. The incidence of thrombophlebitis has been emphasized in order to accentuate the fact that it is relatively low in large series of cases. It seems questionable whether this complication is as important as some groups would lead us to believe. However, since the mortality rate in operations on the colon has been lowered so significantly, it is important that we leave no stone unturned in an attempt to further lower the figures.

Diagnosis. Thrombophlebitis is usually well defined with signs and symptoms which

struction necessitates release of the intraluminal tension by one means or the other, strangulating obstruction requires resection of the nonviable bowel. As has been our custom of recent date, penicillin, as advocated by Calihan,[40] and streptomycin are employed.

Thrombo-Embolism. During the past few years an unprecedented interest has arisen in thrombo-embolic disease. In reviewing our statistics, it was found that the incidence of fatal pulmonary embolism was somewhat higher than that reported by other clinics.

Barker found 16 fatal pulmonary embolisms (0.62 per cent) in 2,571 intestinal resections and 42 fatal pulmonary emboli *in 5,730 abdominal hysterectomies* (0.73 per cent). McCartney in his necropsy series noted that 16 out of 295 deaths (5.4 per cent) were due to pulmonary emboli.

Pathogenesis and Incidence. The exact pathology of venous thrombosis is somewhat controversial. According to De Takats,[57] it has been customary to regard slowing of the circulation, changes in the vessel wall and increased coagulability of the blood as the three factors responsible for thrombosis. Injury to the vessels may occur due to trauma, infections or allergens. Increased coagulability, as well as slowing of the circulation, follows massive injuries and shock and occurs to a lesser degree in less serious injuries or operations. Thrombophlebitis quite frequently is recurrent, particularly following operations or trauma to the lower extremities. Durant[64] has called attention to the fact that postoperatively the rise in the platelet count follows very closely the curve of the incidence of pulmonary emboli.

In 1939, DeBakey and Ochsner[56] emphasized the importance of differentiating between two types of venous thromboses. Their clinical experience and experimental investigation resulted in the conviction that one cannot consider all venous thromboses as the same type of lesion but that it is necessary to distinguish between two types which are different etiologically, symptomatically, prognostically and therapeutically.[156] Homans,[91] Hunter,[97] Veal and Hussey[190] and others[4, 73] agree with this classification.

In acute thrombophlebitis there is antecedent or concomitant inflammation of the vein wall. The clot forms on the intima, is firmly fixed, grows by accretion and tends rapidly to fill the lumen completely. This is the type that occurs frequently following parturition and is different from simple thrombosis or phlebothrombosis, which begins most commonly in the small deep veins of the foot or leg. The chief difference in the two is that there is an absence of important inflammatory reaction in the early *phases of the latter condition* plus a tendency to propagate rapidly and to become dislodged easily. The importance of thrombophlebitis and phlebothrombosis of the lower extremities with ascending thrombosis and thrombosis of the pelvic veins has been stressed in numerous publications during the past four or five years. The investigations of the group at Massachusetts General Hospital have stimulated much interest in this subject, while the work of Ochsner, McCartney and Barker,[23] has been most informative and useful. The attempt to ascertain the incidence of peripheral venous thrombosis and pulmonary embolism has not been too satisfactory, in our opinion. There are many variable factors which enter into the etiology of these complications. This is proven by the variation in some of the statistical studies. In the large series reported by Ochsner and Barker,[24] the incidence of peripheral venous thrombosis was 0.6 per cent and 0.77 per cent, respectively.

This incidence differs somewhat from that found at necropsy. Hunter[96] and his coworkers found at postmortem examination in patients in the latter half of life that thromboses were present in the deep veins of the leg in 52.7 per cent of the cases.

Roessle[172] observed thrombosis of the same veins in 25 per cent of his cases. The incidence also was more frequent in the

findings should be mandatory. One should be apprehensive of patients in the older age group, those who have cardiac disease, those with a history of previous thrombophlebitis, or obese individuals.

Prophylaxis and Treatment. Therapy of thrombo-embolic disease must necessarily begin with prophylaxis or elimination of as many predisposing factors as possible. At present there are two schools of thought concerning the prophylaxis and therapy of venous thrombosis. One is fostered by the proponents of the conservative or anticoagulant therapy and the other by the group which advocates the more radical procedure of venous ligation. Some have deemed it advisable to combine the two methods. In the past two years it has been our policy to follow the more conservative school. Venous ligation has such ardent proponents, however, that its use undoubtedly possesses merit. It is our opinion that intravenous clotting may be prevented in most instances by ardent preoperative and postoperative attention to a few important prophylactic details, use of pressure bandages to the lower extremities in selected cases, careful attention to the cardiovascular system, use of suction to prevent distention, correction of anemia, avoidance of massive trauma, meticulous attention to surgical technic and early exercise of the lower extremities.

Conservative Measures. It is probably safer in all patients undergoing laparotomy, and particularly in those who have varicosities, to wrap the extremities from the toes to the hips with No. 8 Ace bandages immediately postoperatively. This should be continued until the patient is ambulatory. Active exercise of both legs is mandatory during each waking hour, beginning 12 hours after operation. Nurses are all instructed about the importance of the exercises and also about movement to be made by the patient, which must be done frequently without any assistance. It has been our custom following abdominoperineal proctosigmoidectomy especially, for the sake of better drainage, to raise the head of the bed. However, no pillows are used under the knees, and it is our opinion that efforts of the patients to keep themselves moved up in the bed are as valuable as the use of the modified Trendelenburg position. It is the opinion of Wangensteen, Ochsner, De Takats and others that the modified Trendelenburg should be used until the patient is ambulatory and never semi-Fowler's position. The latter position tends to obstruct the venous return at the iliofemoral and popliteal areas. Theoretically this is an excellent suggestion and may have merit.

Early ambulation has been the subject of much discussion. Probably the most beneficial result accruing from this advance in postoperative management has been in the prophylaxis of venous thrombosis. Since this is one of the objectives in early ambulation of the patient, it is our opinion that it should be instituted within 48 hours, whenever possible. Later its value may be doubtful since early thrombosis may already have occurred. Ochsner points to the advantage of true ambulation and not just sitting on the side of the bed or "dangling," since this may obstruct rather than accelerate the venous return from the extremities, with resultant venous stasis. Inasmuch as most of our cases are abdominoperineal resections, the problem of early ambulation has been approached with caution. At present our patients exercise (including dorsal and plantar flexion) vigorously until the fourth or fifth day, when they are out of bed. It is our opinion that this is safer, since no complete peritoneal floor is formed and too early ambulation may result in the small bowel descending into the pelvis.

De Takats recommends the routine use of prostigmine, 1 to 2,000, and sodium tetrathionate in all postoperative cases where thrombosis may occur and in those where there is an increased tendency toward clotting. The latter is determined by the so-called heparin tolerance.

accompany inflammation. Frequently there is pain in the involved extremity, febrile reaction and edema of the extremity. When the deep veins are involved (which is most common), there is a characteristic whiteness of the extremity, as suggested by the term "phlegmasia alba dolens." The temperature of the skin of the involved extremity is cool, which Ochsner implies is a paradox in view of the general increase in the surface temperature. When the superficial veins are involved, the diagnosis is more simple, due to the evident inflammation surrounding the affected vein. De Takats is of the opinion that pain in these extremities is due to associated vasospasm and ischemia. The latter is also responsible for the whiteness of the extremity. Vasodilatation is recommended strongly by Ochsner, who also feels that the edema is due to ischemia and venous blockage.

In contradistinction to thrombophlebitis, the patient with phlebothrombosis may present no symptoms. Most of us have seen fatal pulmonary emboli in patients who have had no symptoms. It has been well established by Hunter and others that these emboli arise from the lower venous channels, which are frequently asymptomatic. If one is to combat serious embolic phenomena, it is necessary to recognize the existence of this condition before it occurs. In other words, the condition must be recognized before it becomes symptomatic, for when this occurs, according to Ochsner, complications have already arisen, frequently in the form of emboli, rapid spread of the thrombosis or infection. Homans[91] first pointed to the presence of deep calf tenderness, which he elicited by dorsiflexion of the foot on the extended lower extremity (Homans' sign). Tenderness over the calf, as well as the plantar veins, is very significant. Allen has[1] stressed the importance of an unexplained concomitant rise in the temperature and pulse in postoperative patients (Allen's sign). The sedimentation rate is invariably elevated; leukocytosis may be present also. In the presence of any of these signs immediate therapy should be instituted. Allen feels that radical treatment during the first seven days of the disease will alter the course of the thrombophlebitis. In fact, during the early phase, they recommend bilateral femoral ligation. The table at the bottom of this page by Veal and Hussey[190] shows the incidence of signs in 84 cases of deep venous thrombosis of the lower extremity.

Moses[118] has described three maneuvers which he found of value in the detection of early thrombo-embolic disease. The first consists of a careful search for tenderness in the deep posterior calf by direct compression anteroposteriorly with the finger tips. The second consists of firm compression of the calf between the fingers and the palm in a lateral direction. (In early phlebothrombosis this is painless, or relatively so, compared with the first maneuver. The great majority of lesions which simulate incipient thrombosis are accompanied by considerable tenderness on lateral compression.) The third maneuver is a brief neurologic examination (cutaneous sensation, position and vibration sense and deep reflexes) to rule out peripheral neuritis, which may simulate thrombo-embolic disease. Durant has also found these examinations of definite value.

Routine examination daily of all postoperative abdominal patients for the above

(Veal and Hussey)

Sign	Present		Absent	Not Recorded
	Significant	Not Significant		
Edema	72 (90%)	0	8	4
Calf tenderness	78 (96%)	0	3	3
Homans' sign	68 (92%)	0	6	10
Fever	12 (14%)	41	31	0
Tachycardia	18 (21%)	49	17	0

50-mg. doses undiluted, intravenously. Simultaneously, oral administration of Dicoumarol is begun, 300 mg. the first, and 200 mg. the second day. Prothrombin levels must be determined daily and maintained between 20 and 30 per cent. The dosage is adapted to daily determination. Heparin is discontinued after two days and anticoagulant therapy is maintained by the continued administration of dicoumarol. When it is used prophylactically, it is discontinued after the patient is ambulatory, in case no symptoms of phlebothrombosis are present. In case of recurrent thromboses it should be used longer. Tapered discontinuance of the substance is recommended since sudden cessation may be followed by thrombosis. The prothrombin time varies rather markedly, as does the coagulation time. When anticoagulant therapy is used, the venous coagulation time should be determined daily (preferably by the Lee-White method). The prothrombin time should be done daily when anticoagulants are administered, and in our cases it is mandatory to determine what this is before they are ordered. It is our feeling that this will prevent many errors in overdosage. It is advisable to keep the prothrombin time below 30 per cent and above 20 per cent. When it drops below the latter figure, it is imperative to give large doses (from 50 to 60 mg.) of vitamin K intravenously to restore the prothrombin time to the optimal level.

Barker and the group at the Mayo Clinic have reported excellent results with the use of dicoumarol postoperatively. They recommend its use for the prevention of thromboembolism and think it advisable to keep the prothrombin levels between 10 per cent and 30 per cent. Venous ligation was not recommended in conjunction with such therapy. Indications for its use are as follows: (1) nonfatal pulmonary emboli; (2) preoperative thrombosis or embolism; and (3) patients in whom thrombo-embolism may occur. Contraindications to the use of dicoumarol are listed as follows: (1) definite renal insufficiency; (2) hepatic insufficiency or jaundice; (3) subacute bacterial endocarditis; (4) purpura of any type; (5) blood dyscrasia with a tendency to bleed, and (6) recent operation on the brain or spinal cord. They feel that it should be given with caution in patients who have (1) ulcerative lesions, open wounds or potentially bleeding surfaces; (2) vomiting due to gastric or intestinal obstruction; (3) continuous or repeated gastric or intestinal drainage; and (4) dietary or nutritional deficiency.

Venous Ligation. The surgical therapy of venous thrombosis has been a subject of much discussion and controversy during the past few years. Credit must be given the group at the Massachusetts General Hospital for emphasizing the importance of venous ligation and establishing definite indications for the various procedures used in the prophylaxis and therapy of venous thrombosis. According to Allen, the methods employed to prevent venous stasis by posture, combined with early passive and active exercise, reduced the incidence of fatal emboli to approximately 1 in 800 surgical cases. This improvement, however, did not eliminate the morbidity, which persisted in spite of intensive conservative measures. So impressed was Allen with the increased danger from fatal pulmonary emboli in the aged that prophylactic femoral vein ligation was practiced, in 1943. In patients with cardiac disease, they also feel that femoral ligation is indicated prophylactically. Linton[124] has recently summarized the chief indications for bilateral femoral vein interruption as follows: (1) the presence of venous thrombosis in the deep veins of the lower extremity; (2) the occurrence of a nonfatal pulmonary embolus, irrespective of whether or not the legs show signs of venous thrombosis; (3) a concomitant rise in temperature, pulse and respiration postoperatively in a patient that cannot be explained by some other cause; (4) venous thrombosis diagnosed in one extremity, even though no signs of the same pathology are noted in the other, and (5) as

Paravertebral sympathetic block should be mentioned here because of the value attached to it by De Takats and Ochsner in the relief of spasm of the peripheral vascular tree with its concurrent symptoms. It is even useful in the differentiation of thrombophlebitis from arterial spasm and arterial occlusion. Ochsner also stressed its importance for relief of pain due to associated arterial spasm and has found that the edema of thrombophlebitis subsides rapidly after sympathetic block. He feels that the edema is due to ischemia from arterial spasm. De Takats also advocates the use of roentgen therapy in thrombophlebitis. Our incidence of thrombophlebitis has been so small that our experience with these various measures has been inconclusive.

The use of anticoagulants prophylactically in cardiacs and patients who may be susceptible to venous thrombo-embolic disease is still somewhat controversial. We began their routine administration in the form of oral dicoumarol on the third or fourth postoperative day in all cardiac patients, those over 50 years of age, all pelvic malignancies and patients who had had *previous embolic disease.*

Anticoagulants. *Mode of Action.* The action of certain impure extracts of liver in inhibiting the coagulation of blood was discovered by McLean, in 1916. Later a series of studies was carried out by Howell and Holt upon extracts of liver from which they obtained a powerful anticoagulant. They give it the appropriate name of heparin. Its action appears to be due to its antithrombinic characteristics, which were demonstrated by Best.[30] It seems to act in at least two ways: first, it retards the rate of conversion of prothrombin to thrombin to an extent which is inversely proportional to the amount of thrombokinase present; second, it reduces the effectiveness of the thrombin formed. Heparin and thrombokinase are direct antagonists, and coagulation is prevented unless thrombokinase is predominant.

Dicoumarol was isolated and synthesized by Link[42, 183] and his associates from sweet clover. Later the action of this substance was studied rather extensively by Barker. He found that administration of dicoumarol orally produced a prothrombin deficiency and applied this substance to the prevention of venous thrombosis. Further, he discovered that it could possibly, but not certainly, lead to severe hemorrhages. It was also observed to be effective in this role when a moderate prothrombin deficiency was produced, although others have held that its anticoagulant effect is obtained through incapacitation of thrombokinase and that it does not enter into the second phase of clotting.

Heparin may be administered by the continuous intravenous drip, by intermittent intravenous or intramuscular injection or by subcutaneous injection incorporated in the Pitkin menstruum.

It should be stated that the indiscriminate and uncontrolled use of the substance led to rather disastrous results, although at present it is relatively safe if administered with care. De Takats recommends the combined use of heparin and dicoumarol, using the former to rapidly decrease the prothrombin levels while dicoumarol is administered simultaneously (orally) for prolonged use. He has not seen the propagation of thrombi during or immediately after discontinuance of the anticoagulant, as reported by Wassermann and Stats.

Ochsner feels that the routine use of anticoagulants is too dangerous. It is his contention that the use of dicoumarol and heparin should be restricted to the group of patients with a thrombosing tendency. In these it should be used prophylactically. He has seen continued dislodgment of emboli during and following the administration of anticoagulants but mentions no fatalities. However, he is of the opinion that their employment does not preclude serious or fatal pulmonary emboli.

It has been De Takats policy to use the anticoagulants in the following manner: heparin is given at four-hour intervals in

½ gr. of papaverine powder in all surgical cases, with from 1/16 to 1/75 of a grain of atropine intravenously, should be administered in 100 per cent concentrations. All interns and nurses should be acquainted with the possibility of this catastrophe and the measures to be instituted.

Pneumonia. True pulmonary infection or bronchopneumonia, while a serious complication, is fortunately not common in the postoperative period. Mason and Zintel[131] observed 30 cases of pneumonia in a series of 246 pulmonary complications; in the group reported by King,[112] the incidence of fatal bronchopneumonia was 7 per cent. Binkley and Deddish[13] cite 5.7 per cent. It is our belief that pneumonia is extremely infrequent and that the cases diagnosed as such are usually pulmonary atelectasis. The physical findings and roentgenographic study are of value in distinguishing between these processes. The author recalls to mind only one instance of fatal postoperative pneumonia in approximately 500 resections.

Pulmonary Edema. Pulmonary edema is a complication which requires medical treatment. The emergency use of venesection is at times a lifesaving procedure and should be mentioned.

Pulmonary Atelectasis. Pulmonary atelectasis, or collapse, is a common postoperative complication and usually is associated with a so-called "pneumonitis" of low-grade toxicity, in which the alveoli are plugged with secretions. In King's group of cases, over 90 per cent of their pulmonary complications were caused by excessive bronchial secretion and its retention in the bronchi as a result of abdominal operation.

In spite of various precautionary measures, our incidence of atelectasis has been extremely high, even though spinal analgesia, well supervised supplemental anesthesia and continuous Wangensteen suction, which lessens vomiting during the operative procedure, have been consistently employed. Routinely, deep breathing exercises are instituted, as well as frequent change in position. The Trendelenburg position is maintained for from 8 to 12 hours, after which the patient is placed in semi-Fowler's for postural drainage. In the application of abdominal dressings, binding the lower thoracic cage is avoided to insure adequate aeration of the lungs. In the presence of an early postoperative febrile reaction that is unexplained on the basis of the operative procedure, one should suspect atelectasis. Increased respiratory rate with mediastinal shift varies according to the size of the atelectatic area and may be found surprisingly frequently when one is observant. Downward displacement of the ribs with narrowing of the interspaces, diminished volume, consisting in displacement of the mediastinum toward the affected side, and elevation of the diaphragm are roentgenographic signs which may serve to distinguish between lobular atelectasis and bronchopneumonia.

Once the diagnosis of atelectasis is made, therapy should be instituted immediately. Conservative measures, such as deep breathing exercises, encouraging the patient to cough, carbon dioxide inhalations, slapping the back and postural drainage are practiced routinely. More successful is bronchoscopic therapy, which may be instituted without harm even if doubt exists as to the pathology. We have been extremely fortunate, in this respect, in having the Department of Bronchoscopy under the direction of Chevalier L. Jackson work with us in these cases. If, however, bronchoscopy is not available, one should learn the technic of catheter drainage, which consists of introducing a stiff rubber catheter into the trachea and bronchi and applying suction. The latter procedure has proved highly successful in our hands. Ordinarily we institute sulfonamide and penicillin therapy.

Genito-Urinary Complications. Surgical removal of the rectum is frequently attended by unpleasant genito-urinary complications. The most frequent encountered are vesical dysfunction, impotence, urinary

a prophylactic measure in patients over 50 years of age who are subjected to major abdominal or pelvic operations for malignant disease. He mentions that in 1,000 patients subjected to femoral vein ligation, there had not been a single fatality. Minor pulmonary emboli following the procedure occurred in 5 per cent of cases. There were two deaths after bilateral femoral vein interruption.

Durant, Barker and others have pointed to the frequent occurrence of pulmonary embolism even after venous ligation has been accomplished. The increasing height of the ligation site is a factor which tends to show *that lower ligations have been* unsuccessful. On the other hand, Ochsner, De Takats and Allen point to failures of anticoagulant therapy. It is difficult to outline the procedure of choice. In our hands the more conservative prophylactic measures have proved successful particularly *with the combined administration of heparin* and dicoumarol.

To August, 1945, there were 439 operations on the colon and rectum, most of which were abdominoperineal resections. In this group there were three deaths from pulmonary embolism and two after sigmoidotomy (1.1 per cent). From August, 1945, to May, 1947 (21 months), not a *single case of fatal pulmonary embolism* occurred, yet during the past year, even though the regime has been even more rigid, two additional deaths have been observed. The measures instituted on our service are based on the investigations of Allen, Homans and others. Each resident and staff member is given the following typewritten form:

PROPHYLACTIC MEASURES

1. Early active exercises of legs hourly when awake
2. Early unassisted movement in bed
3. No pillows under knees
4. Vigilant daily examinations for early signs of deep venous thrombosis
5. Early ambulation—2-4 days, depending on operation
6. Elastic bandages in selected patients

INDICATIONS FOR ANTICOAGULANT THERAPY

1. Tenderness over deep calf veins
   a. Homans' sign b. Moses' sign
2. Unexplained concomitant rise in temperature and pulse (Allen's sign)
3. Previous embolic phenomena
4. Evidence of superficial deep thrombophlebitis
5. Circulatory disturbance of lower extremities
6. Cardiac disease

The results of therapy in 94 cases are tabulated as follows:

	No. of Cases	Mortality
Combination of heparin and/or dicoumarol	92 cases	1
Femoral ligation	1	0
Sympathectomy	1	0
	94 cases	

Pulmonary Embolism. Pulmonary embolism *is not encountered frequently* but is such a severe complication that one must always be on the alert for its occurrence. Its etiology has been discussed elsewhere, and in this discussion we are concerned chiefly with its early recognition and immediate treatment. Prophylaxis was discussed under Thrombo-embolic Disease.

The importance of suspecting pulmonary *emboli in the presence of phlebothrombosis* or thrombophlebitis has been previously emphasized. One should be mindful that fatal emboli are preceded by nonfatal emboli in approximately one third of the cases. They are much more frequent in people over 40 years of age. To recognize the presence of occlusion of the smaller vessels, which includes pain on the affected side with a *friction rub, bloody sputum* and a febrile reaction, is of utmost value. If the possibility of an infarct is kept in mind, the diagnosis is usually not difficult. Electrocardiography and roentgenography are also helpful.

Immediate therapy in these cases is sometimes *lifesaving*. The patient should be kept in a sitting position and papaverine administered. De Takats recommends that

½ gr. of papaverine powder in all surgical cases, with from 1/16 to 1/75 of a grain of atropine intravenously, should be administered in 100 per cent concentrations. All interns and nurses should be acquainted with the possibility of this catastrophe and the measures to be instituted.

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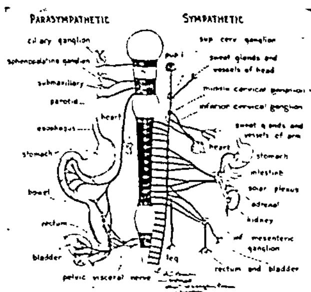


FIG. 734. Scheme of the general arrangement of autonomic nervous system. (*Left*) Origin and distribution of the parasympathetic nervous system. (*Right*) Origin and distribution of the sympathetic nervous system. Reflexes involving an organ supplied by either system may affect other organs so supplied. (From Scientific Exhibit of H. E. Bacon and L. E. McCrea, A.M.A., San Francisco, June, 1946.)

infections and trauma to the genito-urinary organs. In recent years abdominoperineal proctosigmoidectomy has been the most common procedure performed by the author, and the incidence of complications following the procedure has been slightly less than when the Miles' procedure or its various modifications have been used.[49, 71, 103, 119]

VESICAL DYSFUNCTION. Vesical dysfunction is universally considered to be one of the major complications of abdominoperineal resection. McCrea and the author[138] have reported the postoperative follow-ups on 251 cases of proctosigmoidectomy wherein only 7 acquired vesical atony. To the time of this editing (October, 1948), true vesical atony has been observed in 21 instances in a group of 434 abdominoperineal proctosigmoidectomies (10 females, 11 males).

McCrea has used the term "paralytic atony of the bladder" in describing the etiology of the vesical dysfunction, which is rather typical in these cases. Urinary retention, partial or complete, is present. Where this phase is permitted to remain untreated and uncontrolled, dribbling or overflow develops, with occurrence of a superimposed infection. We believe that the most likely cause of this dysfunction is trauma or severance of the innervation to the bladder arising from the hypogastric plexus (sympathetic) and the craniosacral plexus (parasympathetic), with a resultant "nerve imbalance" ensuing. It is McCrea's opinion that the internal vesical sphincter is unable to function and remains in a state of contraction due to an apparent predominant sympathetic influence and that the detrusor is unable to contract due to the loss of parasympathetic innervation. Due to this loss, the authors feel that transurethral resection is not the answer for restoration of normal micturition. McCrea pointed to the possibility of establishment of other sympathetic pathways. He also stated that the bladder undergoes typical atonic changes with acute retention and stasis, thinning of the bladder wall, diverticulation and infection.

It is of interest to note that this is not the consensus regarding the causative mechanism of vesical dysfunction or cord bladder following abdominoperineal resections of the rectum and rectosigmoid. Emmett[72] called attention to the fact that the theory of antagonistic innervation of the bladder by both the sympathetic and parasympathetic nerves has lost most of its proponents; he pointed to the supposition that the sympathetic supply to the bladder (the hypogastric or presacral nerve, which originates in the eleventh and twelfth thoracic and the first lumbar segments of the cord) had little to do with bladder control. The important nerve supply, according to this investigator, is from the parasympathetic system (nervi erigentes or pelvic nerves originating in the second, third and fourth sacral segments of the cord), which carries I

for urinary bladder control. The author further emphasized the role that the pudendal nerve plays in the act of micturition but stated that this was open to question. It does, however, supply the external urethral sphincter, which is supposed to be a semivoluntary muscle. Emmett called attention to the fact that frequently the internal vesical sphincter is resected in transurethral procedures without producing any effect on continence, and it was his belief that the external sphincter is the all-important muscle. Lewis,[122] has also emphasized the fact there is no true internal sphincter, but some investigators assert that continence exists even in the presence of trauma to the external sphincter.

It would seem from the many divergent views in existence that the mechanism of micturition is not so well understood, and it is but natural that controversy should arise over the mechanism of vesical dysfunction in these cases.

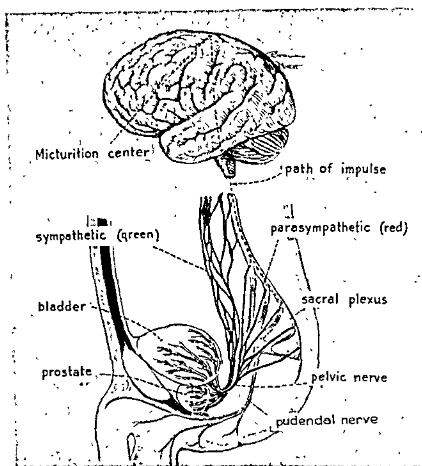


Fig. 735. Schematic drawing showing the micturition center in the brain, the sympathetic and the parasympathetic nerve fibers in relationship to the bladder. (From Scientific Exhibit of H. E. Bacon and L. E. McCrea, A.M.A., San Francisco, June, 1946.)

Coller advances a contention that the incidence and cause of urinary retention following the operation of combined abdominoperineal resection for rectal neoplasm are not clearly known, despite the many studies that have been made of this problem. He attributes this to the difference in

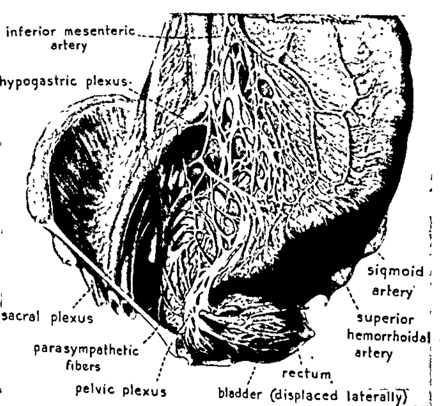


Fig. 736. The normal relationship between the sympathetic and parasympathetic nerve fibers entering into the formation of the inferior hypogastric or pelvic plexus. The bladder and bowel are displaced laterally. (From Scientific Exhibit of H. E. Bacon and L. E. McCrea, A.M.A., San Francisco, June, 1946.)

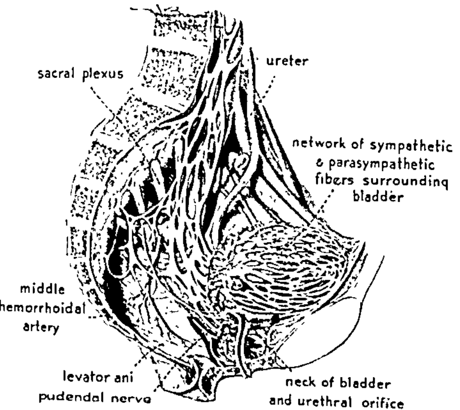


Fig. 737. The relationship of the parasympathetic nerves and the sympathetic nerves is shown. The network of the sympathetic and parasympathetic fibers surrounding the bladder is extensive. The pelvic organs have been removed. (From Scientific Exhibit of H. E. Bacon and L. E. McCrea, A.M.A., San Francisco, June, 1946.)

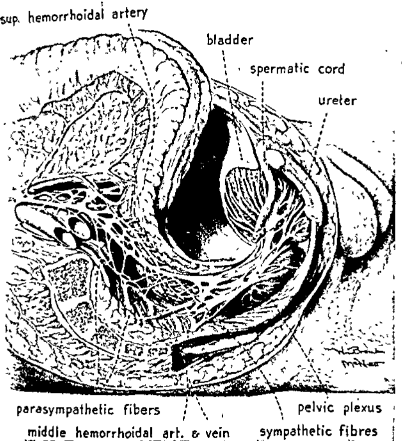


Fig. 738. Sagittal view. The bowel is elevated and displaced laterally. The peritoneum has been reflected. The ramifications of the sympathetic and parasympathetic nerve fibers forming the inferior hypogastric or pelvic plexus supplying the bladder are shown in relationship to the sigmoid. (From Scientific Exhibit of H. E. Bacon and L. E. McCrea, A.M.A., San Francisco, June, 1946.)

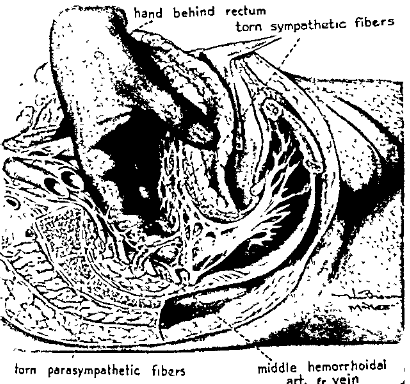


Fig. 739. The inferior hypogastric or pelvic plexus is subjected to trauma by the surgeon when the sigmoid is freed of its pelvic attachments. (From Scientific Exhibit of H. E. Bacon and L. E. McCrea, A.M.A., San Francisco, June, 1946.)

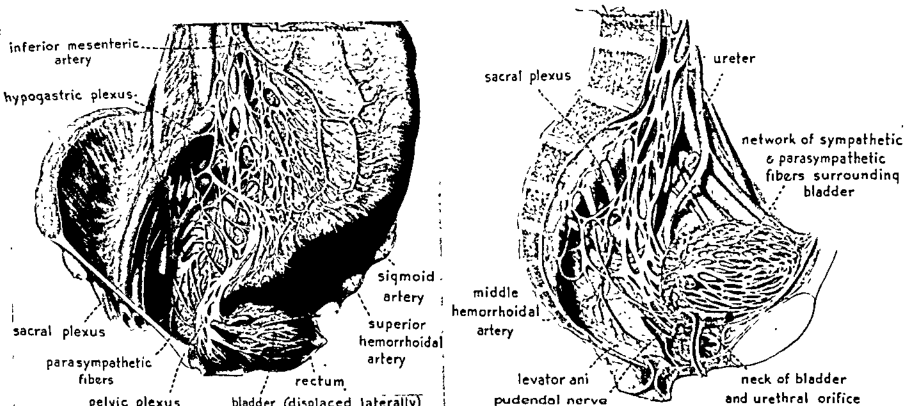


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cystocele, enlarged prostate, median bar and vesical neck contracture, as influential etiologic components of vesical dysfunction. He also recommends transurethral resection to correct the latter and perineorrhaphy for the former and makes use of tidal drainage routinely following rectal resection.

Marshall and the group at Memorial Hospital believe that obstruction at the vesical neck is the chief causative factor for the persistent urinary retention which follows rectal resection. Transurethral resection of the bladder neck has proved of value in their hands and they, too, are advocates of tidal drainage and automatic irrigation of the bladder postoperatively.

Our chief interest has been in devising a means of therapy without further surgical intervention which, at the same time, would be successful in relieving this vesical dysfunction. From cystometric determinations and practical observation of urinary retention with ensuing infection, it seemed obvious that the bladder should be placed at rest. This was not a momentous or edifying observation, for others had followed the same regime for years. However, in combination with repeated cytometric determinations, continuous drainage and daily bladder irrigations, our results in diminishing the morbidity associated with vesical dysfunction have been remarkable, as may be observed from the above statistics. It is also our belief that the use of sulfathalidine has been an important factor in the prophylaxis of urinary infections. Poth and others have concurred in these views.

Management of Vesical Dysfunction. In order to prevent dilatation of the bladder with destruction of the musculature, it is necessary to place the bladder at rest. As a consequence, an indwelling cathether of the Foley type is inserted prior to the time of operation. This catheter is irrigated frequently with boric acid solution and the urinary output is carefully estimated. The catheter is allowed to remain in place until cystometrograms indicate that bladder function has returned to normal. Cystometrograms are usually taken on the fourth day postoperatively, and if the bladder is at all atonic, the catheter is allowed to remain for four days additionally and then the procedure is repeated. Bladder drainage is continued until the cystometrograms approach normal (70 C.M. pressure, normal capacity, tone and emptying ability). Routinely, twenty-four hours following removal of the catheter, the amount of residual urine is estimated, and, if in excess of 60 cc., the catheter is replaced. Urine cultures are obtained with each cystometric determination, and, when positive, treatment is instituted. McCrea believes that the use of 200 mg. syntropan given orally three times daily has been of value in those cases having hypotonia. A few of these patients require observation and the use of an indwelling catheter for several weeks, but none have failed eventually to regain normal vesical function except in two instances where transurethral resection was employed for trial within a very short period after extirpation of the rectum.

Urinary Infection. This complication has not assumed any great consequence in our series, as we have paid rigid attention to the above regime, but it is a factor that should always be kept in mind. In a survey of 118 cases on whom urine cultures were taken prior to operation, a negative report was returned in 61 instances, and 33 of this group remained sterile by culture through the period covered by the operation and postoperative convalescence. It was quite surprising to learn that 57 of the total of 118, or 48.3 per cent, revealed a positive growth on the original culture.

Despite the incidence of these positive cultures, it was unnecessary to institute treatment in any of the cases. Recently, however, we have had two instances of unexplained pyrexia in the presence of positive cultures of *B. proteus*, and upon the institution of treatment, the pyrexia promptly subsided. As stated previously, it is our opinion that sulfathalidine has been a factor in suppressing infection.

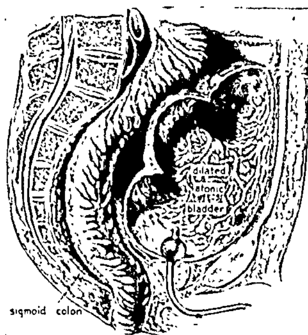


FIG. 740. The dilated atonic bladder following trauma to the inferior hypogastric or pelvic plexus. The diseased bowel has been removed, and a portion of the sigmoid has been drawn into the wound. The atonic bladder wall is thin. Definite outpouching of the wall of the bladder is evident. (From Scientific Exhibit of H. E. Bacon and L. E. McCrea, A.M.A., San Francisco, June, 1946.)

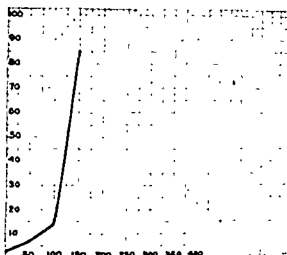
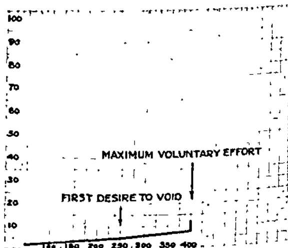


FIG. 741 (*Above*). Normal cystometrogram.

FIG. 742 (*Below*). Hypotonic cystometrogram. This is a typical curve following "proctosigmoidectomy," when *vesical atony occurs. There is a gradual* rise to 10 cm. or below with 400 cc. fill. The first desire to void may vary greatly or may not be experienced by the patient. The maximum voluntary effort is slight. Urination is impossible, as the detrusor cannot contract because of the lack of innervation.



surgical technic and concluded from a study of preoperative and postoperative cystograms that no evidence existed of any trauma to the nerves governing vesical function. He believes that abdominoperineal resection destroyed neither the autonomic nor the somatic nerve supply to the bladder and further he made the statement that the probable cause of urinary retention was local trauma and reflex inhibition.

Emmett and Cristol directed attention to the importance of obstruction at the vesical neck as a cause of retention, particularly in the older group of patients, in which it is persistent. It was his opinion that this was a much more important factor than interruption of the nerve supply or neuro-imbalance. He has applied the principle of transurethral resection to these cases as well as to "cord bladders" with such excellent results that "This postoperative complication has ceased to be a problem." He allows the patients a period of three weeks, during which they are permitted time for recovery of bladder function prior to transurethral resection.

Lazarus has invited attention to the importance of associated factors, such as

pressure of the nerve against the sixth cervical vertebra transverse process has been known to cause cessation of hiccup.

Innumerable measures have been advocated for the treatment of hiccup, although in the main they are less beneficial than those described. A few may be mentioned,[10] such as venoclysis, from 200 to 500 cc. of 20 per cent glucose in saline; Tr. capsicum, 2 minims, or Tr. ipecac, 5 minims every 20 minutes for 4 doses; Tr. musk or Tr. myrrh, 4 cc. in 60 cc. of water given every half hour; chloral hydrate, 1 Gm.; bromide, from 1 to 2 Gm. by mouth or rectum; Tr. iodine, 1 minim in one teaspoonful of water every half hour; tight abdominal binder and forced flexion of the thighs on the abdomen.

Parotitis. Another complication occurring infrequently during the postoperative period is parotitis, which Jones[103] observed in 5 per cent of his cases. In our series of over 800 resections, there has been one case of parotitis. Clinical recognition is not too difficult, and quite often there is a marked pyrexial reaction and a corresponding leukocytosis.

Here again, treatment is best instituted by prophylaxis. Oral sepsis should be investigated prior to operation. Dehydration must be combated, and the routine use of hard candy and chewing gum is advocated. Conservative treatment consists of hot or cold packs, antibiotics and salivary stimulants, roentgen and radium therapy in the early phase of the disease. Where suppuration is present, incision and drainage are indicated.

Perineal Hernia. As frequently as abdominoperineal excision of the rectum is performed, one would expect to find a rather high incidence of postoperative herniation following healing of the perineal wound. A review of the literature reveals that this condition is uncommon.

The first report we were able to uncover in the American literature was that cited by Yeomans.[207] Other instances have been noted.[46, 47, 75, 82, 87, 99, 104, 132, 134, 139, 147, 152, 185]



Fig. 743. A. F.: Hernia following Miles resection five years previously. The soft swelling caused bulging of the region of the perineum from the coccyx to the vaginal opening. This swelling was reducible by taxis. The margins of the levator muscles or perineal floor could be felt when the herniation was reduced. Hernia successfully repaired by intra-abdominal approach.

An analysis of the cases reported was made by our resident, Dr. Rowe, in an attempt to determine the factors predisposing to this complication. Of the 16, 10 were females and 6 males. A Miles type of abdominoperineal excision was performed in 9, and a perineal proctectomy in 3; the perineal wound was apparently closed in 5 of the Miles resections and partially closed in 2 perineal proctectomies. The wound was permitted to remain open in 3, and in 2 the treatment was not specified. Six cases were repaired with good results, while no attempt was made to repair the remainder. The coccyx was excised in 3 and probably removed in 4 others.

Babcock has encountered 2 cases follow-

Treatment depends on the type of organism and its susceptibility to the antibiotics or sulfonamides. Changing the reaction of the urine and adequate fluid intake is usually sufficient to dispose of any urinary infection.

IMPOTENCE. This complication is mentioned solely to call attention to the low incidence of impotence following abdominoperineal proctosigmoidectomy. Since complete preservation of the sphincter muscle has been instituted, the percentages have been reduced from 55.5 to 8.3, a decidedly appreciable reduction.

Wound Injection and Dehiscence. Our experience in this field is limited, since wound complications in recent years have occurred infrequently. In a series of 251 abdominoperineal proctosigmoidectomies, there were two instances of abdominal wound infection (0.79 per cent) where a left diagonal or Babcock incision was employed. There were no wound disruptions. From June, 1946, to June, 1947, the left paramedian incision was utilized in approximately 130 resections in which there were three instances of wound infection (2.3 per cent) and one dehiscence. It is our belief that to a great measure this low incidence has been due to maintenance of adequate protein and vitamin C levels and to the use of Babcock's alloy steel wire. It should be mentioned that Jones reported an incidence of infection in 28 per cent where catgut was employed, compared to 2 per cent for alloy steel wire. At the time of this editing (October, 1948), there have been three instances of dehiscence during the past several months. In all a left paramedian incision was used, but a review of the operative records of these three cases shows that the peritoneum was closed with catgut, while the fascia, subcutaneous tissue and skin were closed in layers with steel alloy wire. It is Babcock's opinion that this complication in our cases resulted from the use of catgut in the peritoneum.

Hiccup (Hiccough) (Singultus). A not infrequent sequel to abdominal operations is singultus, which is produced by spasmodic contraction of the diaphragm with simultaneous closure of the glottis. The underlying factors have been classified by Mason and Zintel[133] as reflex, toxic, neurotic and infection. The occurrence of this symptom toward the end of the first postoperative week may serve as a sign of serious underlying pathology, such as abscess formation, intestinal obstruction or generalized peritonitis.

TREATMENT. The underlying cause should be recognized and treated accordingly. However, the diaphragmatic spasms may continue in spite of such treatment and will require symptomatic therapy in addition.

It has been our experience that a combination of gastric and intestinal suction and carbon dioxide inhalation is the most effective. Inhalation of this gas for from four to six minutes frequently produces temporary remission of the hiccup. The rationale of this therapy is in doubt, but it may well be that the spasmodic diaphragmatic contractions which cause hiccup are replaced by the regular contraction impulses from the respiratory center, which is stimulated by the inspired carbon dioxide.

If the symptomatic therapy just described is not effective, the phrenic nerve, or nerves, may be blocked with novocaine, or crushed or avulsed. Under fluoroscopy it may be determined which leaf of the diaphragam is undergoing the irregular contractions. Impulses in the appropriate nerve may then be blocked by the regional infiltration of from 30 to 60 cc. of 1 per cent novocaine[196] or by injection of 2 cc. of the same solution into the phrenic nerve as it crosses the scalenus anticus muscle. The effect is prompt and lasts up to eight hours. Failure to obtain quick results may indicate nerve anastomoses below the site of the block. Avulsion is then necessary. Weeks[199] has mentioned that two cases responded satisfactorily where phrenic nerve division or avulsion was performed bilaterally. Simple

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ing proctosigmoidectomy. Both were satisfactorily repaired. From this brief survey, one may conclude that perineal hernia is more common in women. Closure of the wound does not decrease the incidence nor does removal of the coccyx. Successful repair may be expected.

Our experience has been limited to 2 cases: one a male, age 73, developed a perineal hernia 25 months following abdominoperineal proctosigmoidectomy, which was satisfactorily repaired by utilizing the obturator internus, the stumps of the levator and the gluteus maximus muscles. The second patient, a female, age 69, had had a Miles resection for cancer performed five years previously. Repair was accomplished by an intra-abdominal approach (Fig. 743).

Megacolon. An interesting but rare complication following resection is reported by Wilensky.[203]

Early Ambulation

During a brief period in the early portion of this century, Ries and Kümmel were chiefly responsible for the use of early ambulation following operative procedures which subsequently fell into disrepute. The method, however, has recently awakened interest in various surgeons.

In 1935, Kimbarovsky[111] reported 551 cases, including herniorrhaphies, appendectomies and gastric resections, in which postoperative pulmonary complications, wound infections, thrombosis and embolism were markedly decreased. In a subsequent publication,[110] he reported a series of 1,600 cases with similar results. Niedeggen,[154] in 1940, published the results of early ambulation in 1,646 cases with a decrease in postoperative complications. Campaneau,[41] in 1938, reported 1,300 cases of various types in which early ambulation was instituted with excellent results.

In this country, Leithauser and Bergo,[121] in 1941, reported 436 cases in which the majority of patients were out of bed within 48 hours. In subsequent publications,[120] he also further advocated the institution of early ambulation.

Since these initial reports, the literature has been replete with publications verifying the use of early ambulation,[9, 153, 169] with a reduction in postoperative complications and thrombo-embolism. Early ambulation has been advocated with very little reservation by so many outstanding observers that we fear it has been overemphasized. In the cases with which we are dealing in this discussion, our attitude has been somewhat conservative. Ravdin[169] ambulates his abdominoperineal resections in 48 hours. Following Miles resections this may be safe, but even here the procedure is questionable. It has been our practice in these cases and also in the abdominoperineal proctosigmoidectomies, to insist on early exercise of the lower extremities and active movements of the patients from side to side. For more than three years ambulation has been initiated on the fifth and sixth day and more recently on the fourth and even the third. Earlier than this the possibility of small bowel obstruction in the pelvis, in our opinion, makes ambulation unwise. The importance of early leg exercises and change in position have been mentioned previously. Following end-to-end anastomoses, it is safer to ambulate the patient earlier (48 hours), and in time we may come to the conclusion that it is more advantageous to use it in all types of resections.

In this as in other newer concepts of therapy, we try to maintain an open mind and attempt to individualize our cases in regard to age, nutritional status, extent of the operation, appearance of the wound, postoperative reaction, the presence of drains, etc. With such a regime, our results have been fairly satisfactory in connection with thrombo-embolism, wound infection, disruption and other factors. Our experience with early ambulation has been discussed further under Malignancy, Chapter 19, Part 3, page 748.

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CHAPTER 29

Alloy Steel Wire: Its Practical Use as Suture Material in Surgery

Sutures are the servants of those who would become masters of surgery and surgical technic. To be efficient and to conform to all the requirements of function allotted to them they must, or should, possess the following attributes:

(1) Uniform tensile strength;
(2) Ability to produce smooth coaptation of wounds to which they are applied;
(3) Restoration, in so far as possible, of the cosmetic appearance of the part and, when necessary, longevity.

It must be borne in mind that many factors enter into the function of wound healing, one of them being the materials used for ligatures and sutures. The relative advantages of both absorbable and nonabsorbable sutures have been subjected to considerable study and discussion.

The Biblical phrase, "There is no new thing under the sun," might be aptly applied here, as the use of metal sutures is not of recent origin. Dulin,[3] in 1943, in his discussion of the use of alloy steel wire as suture material, stated that J. P. Mettauer and J. M. Sims nearly a century ago demonstrated the value of nonirritative metallic suture in solving the closure of difficult vesicovaginal fistulae.

Babcock, in 1932,[2] and later in 1935,[1] was the first to report the advantages of alloy steel wire. Of particular importance is the work of Preston,[10] who, in 1940, published his article on the effects of sutures on the strength of healing wounds. In this article he demonstrated that the tensile strength of wounds sutured with wire is greater than that of those which had been closed with either silk or catgut. Babcock[2] stated that from its resistance to chemical change, modern alloy steel wire has been called "the new noble metal." It was his opinion that soft or annealed stainless steel wire has marked tensile strength, can stretch over one third of its length before breaking and possesses such resistance to corrosion that, when it is buried in the tissues for prolonged periods of time, it will remain untarnished and does not give rise to tissue discoloration or local irritation. It has, even after three months under a plaster cast, retained its brilliant luster and shown absolutely no tendency to cause tissue irritation.

It can very satisfactorily be substituted for the weaker and more brittle silver and bronze wires and can replace, with decided advantage, horsehair, silk and dermal as a fine approximating suture and silkworm gut as a strong, supporting, through-and-through suture. The finer size of wire adapts itself readily to tying into the ordinary square knot without breakage or losing any of its appreciable tensile strength and, in addition, may even be used to ligate blood vessels.

The toleration of living tissue to this wire was demonstrated by the author, who buried interrupted sutures and ligatures of fine wire in both septic and clean wounds in order to avoid tissue reaction to either catgut or silk. It possesses the added advantage of distinctly moderate cost, as nearly a mile of the fine, stainless steel wire may be purchased for a dollar.

In an article on catgut allergy, Babcock[1] warned against the many reactions produced by this material, stating that from the commercially prepared catgut, a "his-

concentration of oxygen in experimental shock, Surgery 8:247, 1940.
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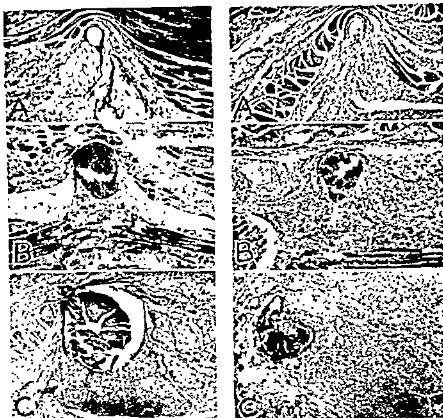


FIG. 746 (*Left*). Tissue reaction to sutures, two days after application. Magnified 40 times. (A) Wire (represented by an oval empty space in all illustrations). Note absence of cellular infiltration around suture and only slight inflammatory reaction in surrounding tissues. (B) No. C silk. Suture is partially encircled by purulent exudate, with moderate inflammatory reaction in surrounding tissues. (C) No. 1 chromic catgut. Very extensive acute inflammatory cellular infiltration. (Y. K. Wu and H. C. Pai: Surg., Gynec. & Obst. 74:110.)

FIG. 747 (*Right*). Tissue reaction to sutures, five days after application. Magnified 40 times. (A) Wire. There is a moderate number of fibroblasts around the suture. Note the marked constriction on the tissue in this section. (B) No. C silk. The acute inflammatory reaction in the surrounding tissues is subsiding; granulation tissue has formed in the surrounding tissues. (C) No. 1 chromic catgut. Very extensive purulent exudate still is present. (Y. K. Wu and H. C. Pai: Surg., Gynec. & Obst. 74:110.)

roidectomy. This material, while carrying a mixed blessing to the surgeon for its very desirable asset of absorbability, causes a corresponding source of liability from these allergic reactions acting to retard healing. Even with the use of chromic gut, a wound may open four or five days later with most of the gut absorbed, and again, small pieces of intracuticular suture, labeled "00-plain," may extrude from the skin weeks following its insertion. It cannot be sterilized by any of the known chemical methods.

In 1937, Dulin[4] and his associates began closing some abdominal wounds with interrupted, through-and-through sutures of 22-gauge stainless steel wire. The technic used was that described by Reid, Zinninger and Merrill, with the exception that these sur-

tamine-like substance" may be isolated (Gruskin). It is to be remembered that histamine, even in minute quantities, is capable of producing anaphylactic shock. It is especially noticeable that these allergic reactions to catgut appear following thy-

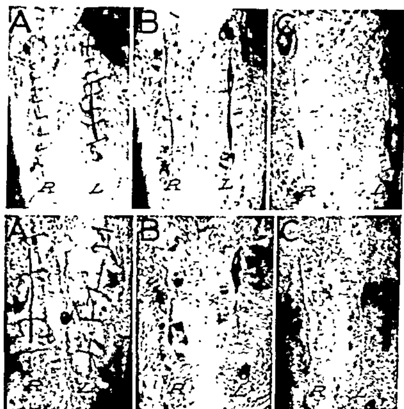


Fig. 744 (*Top*). Abdominal wounds infected with a saline suspension of dogs' feces. The rectus sheath has been closed with No. 35 alloy steel wire on the right side and No. 1 chromic catgut on the left side. (A) Three days after operation. Wire wound, slightly swollen. Less than 10 cc. of pus evacuated. (B) Five days after operation. Wire wound, healing; discharge scanty. Catgut wound, still swollen with moderate amount of pus. (C) Twelve days after operation. Wire wound, almost completely healed. Catgut wound, still discharging pus. Whole incision is undermined; complete healing, 10 days later. (Y. K. Wu and H. C. Pai: Surg., Gynec. & Obst. 74:110.)

Fig. 745 (*Bottom*). Abdominal wounds infected with a saline suspension of dogs' feces. The rectus sheath has been closed with No. 35 alloy steel wire on the right side and No. C silk on the left side. (A) Three days after operation. Wire wound, moderately swollen; 5 cc. of pus evacuated. Silk wound, markedly swollen; 10 cc. of pus evacuated. (B) Seven days after operation. Wire wound, healing, except for superficial necrosis; discharge scanty. Silk wound, moderately swollen with purulent discharge. (C) Fourteen days after operation. Wire wound, completely healed. Silk wound, upper two-thirds of wound undermined. Wound drained for 43 days and healed only after it was reopened and some silk sutures were removed. (Y. K. Wu and H. C. Pai: Surg., Gynec. & Obst. 74:110.)

wounds that had disrupted. Where infection had become superimposed, a more distinctly marked pathologic change was in evidence.

The process which obtains when organic materials become accidentally introduced into wounds is the same, in that the primary response of the body on closing a wound with an absorbable suture material is an attempt to expel the irritating foreign substances; the difference is one of degree only, although it is true that certain foreign protein materials, notably silk, give rise to a less pronounced cellular response.

The main object of any suture material is that it be strong enough to hold the tissue edges together until healing has occurred, and Dulin found the improvement in wound healing so definite where wire was used that its use was extended in the repair of all hernias on their general surgical service. They, in addition to other surgeons, demonstrated that the superior qualities of wire which result in improved wound healing are not wholly due to its physical property of strength, but rather to the tolerance of tissues to the wire.

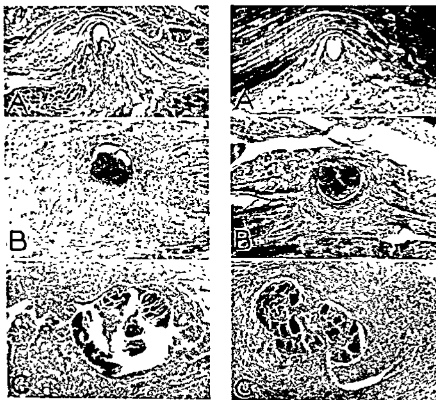


Fig. 750 (*Left*). Tissue reaction to sutures, nine days after application. Magnified 40 times. (A) Wire. The inflammatory reaction has entirely subsided; slight fibrosis is seen. (B) No. C silk. The suture is surrounded by organizing granulation tissue. (C) No. 1 chromic catgut. Fragmentation of the suture has occurred. There still is much leukocytic infiltration and granulation tissue. (Y. K. Wu and H. C. Pai: Surg., Gynec. & Obst. 74:110.)

Fig. 751 (*Right*). Tissue reaction to sutures, 13 days after application. Magnified 40 times. (A) Wire. Very little fibrosis is seen. (B) No. C silk. Moderate fibrosis. (C) No. 1 chromic catgut. The suture still is surrounded by granulation tissue. Fibrosis is taking place at the periphery. Note the infiltration of leukocytes between the fragments of the suture. (Y. K. Wu and H. C. Pai: Surg., Gynec. & Obst. 74:110.)

geons used silver wire. This closure had been used where difficulty had been encountered because of unusual degree of abdominal distention, poor structural condition of the wall, the probability of infection or when a neoplasm of marked general debility was present.

These authors found that the study of wounds reopened on the wards or in the operating room during varying stages of healing proved quite instructive. They observed that following closure of large abdominal incisions with strong catgut, even two weeks' time proved insufficient to prevent the surgeon from opening the entire wound with a minimal amount of traction put on the edges. In such wounds these investigators came across varying amounts of seropurulent material, rough, friable, grayish-white, necrotic tissue and broken strands of the catgut undergoing disintegration; this they found especially common in

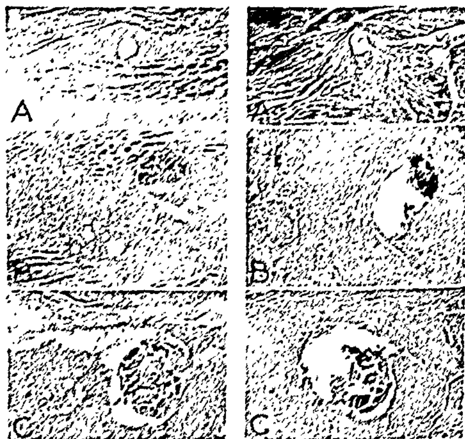


FIG. 748 (*Left*). Tissue reaction to sutures in infected wounds, eight days after application. Magnified 40 times. (A) Wire. The inflammatory reaction has subsided and fibrosis has begun. (B) No. C silk. Extensive granulation tissue formation is evident with infiltration of leukocytes around and into the suture. (C) No. 1 chromic catgut. The reaction is even more marked than in (B). Note marked fragmentation of the suture. (Y. K. Wu and H. C. Pai: Surg., Gynec. & Obst. 74:110.)

FIG. 749 (*Right*). Tissue reaction to sutures in infected wounds, 14 days after application. Magnified 40 times. (A) Wire. Slight fibrosis. (B) No. C silk. The suture is surrounded by granulation tissue with marked leukocytic infiltration. (C) No. 1 chromic catgut. The suture has been partially absorbed. Extensive granulation tissue and purulent exudate are present. (Y. K. Wu and H. C. Pai: Surg., Gynec. & Obst. 74:110.)

wounds that had disrupted. Where infection had become superimposed, a more distinctly marked pathologic change was in evidence.

The process which obtains when organic materials become accidentally introduced into wounds is the same, in that the primary response of the body on closing a wound with an absorbable suture material is an attempt to expel the irritating foreign substances; the difference is one of degree only, although it is true that certain foreign protein materials, notably silk, give rise to a less pronounced cellular response.

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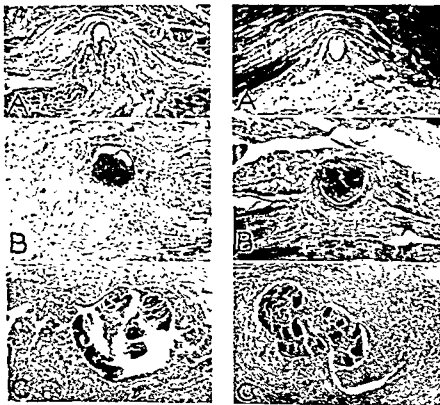


Fig. 750 (*Left*). Tissue reaction to sutures, nine days after application. Magnified 40 times. (A) Wire. The inflammatory reaction has entirely subsided; slight fibrosis is seen. (B) No. C silk. The suture is surrounded by organizing granulation tissue. (C) No. 1 chromic catgut. Fragmentation of the suture has occurred. There still is much leukocytic infiltration and granulation tissue. (Y. K. Wu and H. C. Pai: Surg., Gynec. & Obst. 74:110.)

Fig. 751 (*Right*). Tissue reaction to sutures, 13 days after application. Magnified 40 times. (A) Wire. Very little fibrosis is seen. (B) No. C silk. Moderate fibrosis. (C) No. 1 chromic catgut. The suture still is surrounded by granulation tissue. Fibrosis is taking place at the periphery. Note the infiltration of leukocytes between the fragments of the suture. (Y. K. Wu and H. C. Pai: Surg., Gynec. & Obst. 74:110.)

A precautionary note is stressed here, the possibility of a member of an operating team receiving a puncture wound of the hand; this is an ever-present danger. The perforation or tearing of rubber gloves will break the sterile technic and is to be constantly guarded against.

Preston[10] stated that an upper abdominal incision which had been closed with anealed stainless steel wire, when reopened, showed firm union of the wound edges which strongly resisted pull on retractors. The beginning production of white, fibrous tissue was evident at the termination of two weeks in this wound, and a scalpel was required to divide the layers, quite definitely opposite to the friable, unhealthy appearance present in wounds closed with catgut. In a series of animal experiments, the sutures used were stainless steel wire which, in the end, was the only suture material fulfilling the requisites for ideal suture. Gross infection was entirely absent in all wounds closed with wire but was present in some of them which had been closed with silk, chromic catgut and plain catgut. Preston, by these experiments, found that the type of suturing which resulted in the strongest skin wounds was the interrupted, loose, small-bite stitch, and those wounds which were found weakest had been closed with the continuous, tight and big-bite stitch.

While no definite conclusions were reached by Lupton,[8] who advocated the use of silk suture material, it did seem to him that some justification for a favorable impression regarding it resulted from its use by this surgeon. In his experience, the lower postoperative temperature curves, fewer resultant complications and milder postoperative periods were due to the use of this material, where meticulous attention to hemostasis and gentleness in handling tissues had been additionally observed. He found it to be definitely superior to catgut in regard to wound complications. Owing to the smallness of this series, which was composed mostly of private patients, comparison with this method and that of steel wire material for wound closure is not justifiable.

In the military services, where "good surgery" meant rehabilitation of the fighting units in the most rapid manner commensurate with preservation of life, early ambulation was effected to an increasing degree by the use of steel wire sutures.[13] Vickers found it to be the ideal material for use in the presence of infection, since it cannot harbor or act as a focus for bacterial growth, and, in addition, fewer sutures were necessary when this material was used, since they are permanent and their holding power constant and secure. This operator found that suture ends must be cut short enough so that they will be "on the knot," preventing the ends from pricking adjacent tissue, which pricking, while not resulting in appreciable damage, can be annoying if the underside of the skin becomes irritated. It can, however, act as a "foreign body" if too large a gauge is used as a running suture, and a draining sinus at times results when such a type of wire is used.

The use of alloy stainless steel as advocated by Babcock (*op. cit.*), gave good results on Vicker's service. He found it nonelectrolytic, nonmagnetic and nonallergic. Its greatest advantage, accruing from its use in the naval medical services, was that it insured an incisional security. This, combined with good surgery, permitted early postoperative ambulation, which, in turn, lessened the liability of pulmonary and peripheral vascular complications and protected the patients in the event that military action required their rapid evacuation from the ship.

Sizer,[11] by experiment with collagen sutures and surgical catgut, discovered that suture absorption in man may be greatly accelerated during the presence of postoperative fever, an additional reason why these sutures are inferior to alloy steel wire.

Large[6] demonstrated by animal experimentation that alloy steel metallic sutures



FIG. 752 (*Left*). Alloy stainless steel, No. 36, in quadriceps muscle after three weeks. This shows the milk cellular reaction occurring in the intermuscular septum. (*Center*) Alloy steel, No. 36, in subcutaneous tissue for three weeks. (A) Indicates the suture site, showing the least reaction of any sutures treated. (*Right*) Silk untreated, after three weeks, showing the cellular infiltration surrounded by normal muscle. (O. P. Large: Am. J. Surg. 60:418.)

gave the minimal reaction with the maximum of tensile strength of wound. Cotton, silk, either plain or waxed, plastigut, nylon and catgut showed increasing degrees of reaction, in the order mentioned. Plastigut showed excess fibrosis, while nylon stimulated epithelialization or the proliferation of squamous cells in tissues through which the suture passed. Intestinal anastomoses using alloy steel wire as an interrupted seroserous suture gave practically no reaction and were free of adhesions at the end of two weeks.

Meade and Ochsner,[9] in an extended series of experiments, concluded that catgut, by producing the most reaction and slowest healing, was graded as 4 in the order of wound healing; linen as 3; silk, 2; and cotton, producing the least reaction and earliest healing, was graded as 1. They found that catgut was distinctly unreliable when knotted under tension and, above all, was a definitely possible source of wound infection. Additionally, it could be a source of allergic tissue reaction. Cotton and linen, being products of the field, may contain spore-forming anaerobic pathogens, and silk may contain, on occasion, the ordinary pyogens. All this is detrimental to their use.

In an exhaustive experimental and statistical treatise about wound healing, Localio, Casale and Hinton[7] have demonstrated that, grossly, little difference was observed among wounds sutured with nonabsorbable materials. Serum was not in evidence in appreciable amounts when cotton, silk, wire or nylon was used. Furthermore, it was quite unusual to find serum in the subcutaneous tissues after the third or fourth day in animals whose wounds were sutured with nonabsorbable material. Catgut-sutured wounds, on the other hand, contained serum in varying amounts up to the ninth day. The wounds appeared pale, and a fibrinopurulent material like a membrane was present along the fascial and peritoneal suture line between the second and seventh day. Very few of the wounds sutured with nonabsorbable material showed this membrane, and only between the second and fourth days. Catgut wounds also presented edema for longer periods of time, and matu-

ration of fibroblasts and collagen was retarded. The most significant difference was in the inflammatory reaction. In catgut wounds it was acute, intense, prolonged and associated with widespread death of tissue and abscess formation. In those wounds sutured with silk and cotton, the inflammatory reaction was somewhat more intense and prolonged than in the case of nylon-sutured and wire-sutured wounds, but healing occurred at about the same rate. Studies of tensile strength agree with these observations.

It was of interest to note that fragments of chromic catgut were observed in wounds at the end of two months and that an inflammatory reaction was still present about the suture material at this time. Wounds sutured with nonabsorbable material also showed this material to be present at the end of two months, but it was fragmented and encapsulated by fibroblasts showing evidence of a foreign body reaction.

The authors demonstrated two factors apparently responsible for the prolonged time lag in healing observed in catgut sutured wounds: (1) the marked destruction and acute inflammation which necessitated a prolonged period of débridement; (2) delay in the maturation of fibroblasts and collagen, due, in all probability, to an acute inflammatory reaction. The delay in final healing of catgut-sutured wounds, which was noted in their studies of tensile strength and microscopically, was attributed to the more widespread destruction and acute inflammation of tissues within these wounds.

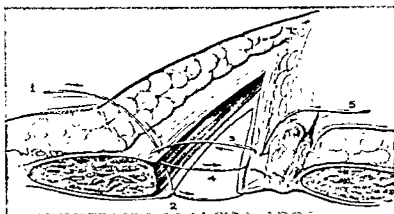


FIG. 753. Smead figure-of-8 stitch through (1) fascia, peritoneum, (2) peritoneum, fascia, (3) fascia and fascia.

In conclusion, therefore, it would be reasonable to suppose that there exist many cogent reasons for the preference of alloy steel wire suture material, especially in surgery of the anus, rectum and sigmoid colon.

In our department, alloy steel wire, recommended by Babcock, has been employed for a period of approximately ten years. Closure of the abdomen is effected by a continuous catgut stitch for peritoneum, interrupted sutures of alloy steel wire (A.S.W.) 32-gauge for fascia, interrupted sutures of A.S.W. for subcutaneous tissue and a continuous suture of A.S.W. 35-gauge for skin. During the past two years we have employed the Smead[12] figure-of-8 suture (fascia peritoneum, peritoneum fascia and fascia fascia) as popularized by Jones[5] with satisfaction. As previously reported by the writer,[3] abdominal wound infection and dehiscence have been infrequent complications. In fact, in a series of 251 resections, there were only two instances of wound infection, an incidence of 0.79 per cent. To a great measure, we believe this was due to the use of sulfonamides, maintenance of adequate protein and vitamin C levels, employment of the oblique muscle-

splitting incision and Babcock's alloy steel wire. (See author's recent note, p. 1060.)

For the second layer of end-to-end anastomosis, 36-gauge or 38-gauge A.S.W. has offered no untoward results. In the closure of complicated and complex fistulae, such as sigmoidal, recto-urethral and rectovaginal fistulae, alloy steel wire may be employed. The same may be stated for correction of sphincter incontinence. For ten years at least, all pilonidal cystectomies have been treated by excision and subcutaneous approximation with 32-gauge A.S.W., although the skin in itself is never closed. Although our series does not compare with the groups encountered during World War II, the results are gratifying, and there is less evidence of recurrence.

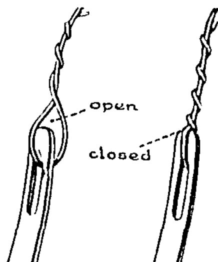


FIG. 754. Magnified view of eye of needle showing correct (closed) and incorrect (open) method of looping wire.

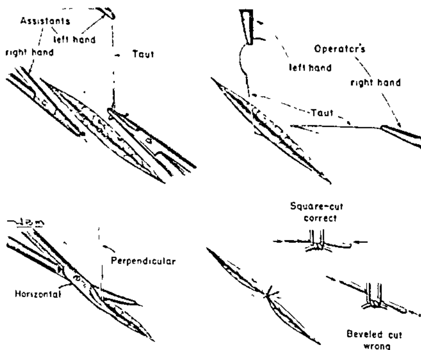


FIG. 755. Illustration showing technic of using wire suture material. (*Top left*) Right hand of assistant draws needle through as left hand of assistant keeps wire taut. (*Top right*) Right hand of assistant drawing needle through skin, left hand of assistant passing hemostat to operator. Wire is held taut at all times. (*Bottom left*) Wire is cut in perpendicular fashion, but each wire should be cut separately and not together as shown. All wire to be buried is cut immediately above the knot. Wire in skin, which will be removed subsequently, is cut in one-half inch lengths. (*Bottom right*) One wire suture has been placed in skin. Manner of cutting wire is correctly and incorrectly shown.

SUGGESTIONS IN THE USE OF BABCOCK ALLOY STEEL WIRE

1. Sterilization: from 18 to 20 lbs. pressure for 10 minutes
2. Wire: cut in 18-inch lengths to avoid kinking (avoid spools)
3 Size of wire:

for serosal stitch	—36 to 38 gauge
for peritoneum	—32 "
for fascia	—32 or 30 "
for figure-of-8— (peritoneum & fascia)	32 " " "
for subcutaneous	—35 "
for skin	—35 or 36 "
for pilonidal wounds	—30 or 32 "
for repair of rectovaginal and recto-urethral fistula	—32 or 35 "
for sphincter muscle repair	—32 or 35 "

4. Type of suture: interrupted sutures in all except skin, which may be continuous (35-36).
5. Knots: square knots only, must be cut immediately above second knot and at right angles to long axis. Some prefer cutting between the second and a third knot, while others bend and invert ends. A third knot is undesirable, since a "slip knot" may be produced. Inversion of ends should be avoided. Knots should always be tied with hemostats for accuracy. Stranded is braided, stainless steel wire. It is strong, has greater flexibility and less tendency to kink but should be restricted to clean wounds.
6. Cutting wire: always at right angles to long axis and with hard steel scissors (denture type).
7. Removal of sutures: only skin sutures are removed.

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